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The Gardens' Bulletin

STRAITS SETTLEMENTS

Vol. IV MARCH 1927 Nos. 2 & 3

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THE

GARDENS' BULLETIN

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Vol. IV. March, 1927. Nos. 2 & 3

Some old photographs of the Singapore Gardens

By the courtesy of the Director of the Royal Botanic Gardens, Kew, we have been provided with a set of old photographs of the Singapore Gardens, which we believe have never been published. They were taken about the year 1877, when H. J. Murton was Superintendent.

On the accompanying plates we publish a photograph from this collection taken on the top of the Bandstand Hill (Plate I), and a recent one taken as nearly as possible from the same position (Plate II).

The old photograph takes in a wider angle than the recent one, and it is not possible to make the two match exactly, but they have certain features in common which enable a comparison to be made. The Bandstand area itself is evidently the same now as in early days. In the recent picture the extreme right-hand portion of the raised area, and the palms which adjoin it, are not shown; the other palms of the ring (*Actinorhytis calapparia*) are seen, though their heads could not be included in the picture.

The fine tree of *Koompassia malaccensis* is prominent in the background, near the middle of both pictures; evidently in 1877 it was nearly as tall as now, and its age must be considerable. On the right of the recent photograph appears the beautifully regular form of a jelutong tree (*Dyera costulata*): the dark tree on the right of the old picture may be the same individual, or possibly the *Artocarpus lanceifolia* which is very close to it. On the right of the Koompassia in 1877 is seen a clump of the traveller's palm (Ravenala). This still exists, but is hidden by the congea bush in the foreground of the recent photograph. The large tree in the background on the left of the old photograph is probably the fine *Shorea leprosula* (Seraya batu) killed by lightning in 1909 (see Agric. Bull. S.S. and F.M.S., Vol. VIII, plate opposite p. 364).

On the left of the picture of 1877, in the background, appear trees covered with creepers. These trees stand between the Upper

and Lower Ring roads round the Hill. In Murton's reports of 1877 and 1878 it is recorded that a fern rockery was started under some trees in this position, but their death and collapse in 1877, owing to the smothering of creepers which grew over them, caused the site to become too open for ferns. The present rockery on the north-west of the Bandstand Hill was established later by Cantley, beyond the Lower Ring Road. Two other photographs (not here published) show the creeper-covered trees in closer view, and enable their position to be located fairly accurately. The creeper which smothered them was probably *Thunbergia laurifolia*, which still continually causes much trouble. It occurs in many parts of the Gardens and has frequently to be cut back, to prevent further disasters like that which spoiled Murton's rockery.

Another photograph in the collection shows the road through the Gardens Jungle (now called Liane Road); the jungle adjacent to the road was not so well grown as now, and the road much more open. Another shows a view down Maranta Avenue, and indicates that the palm valley and its slopes, below the Director's house, had not then been planted with the palms which are now there.

Other pictures in the southern part of the Gardens show equally great changes. The island in the lake was covered by spreading trees (of which the largest was probably a Waringin) instead of the graceful clump of nibong palms and fine pandans which now adorn it. The avenue of sealing wax palms (*Cyrtostachys lakka*) on the south side of the Bandstand Hill had not been planted, and a view southwards from the site of that avenue shows the monkey house (then newly erected) in its original position near the present herbarium, and beyond it on the horizon the buildings of Tanglin Barracks, not then hidden by all the trees which have since grown up. It is hoped to publish others of these photographs in later issues of the Bulletin. Further details concerning the history of parts of the Gardens here mentioned are recorded in the papers published by Mr. Burkill in Volume II of the Bulletin, pp. 55-72 and 93-108.

R. E. Holttum.

Additions to the Flora of the Malay Peninsula

By M. R. Henderson, F.L.S.

ANONACEAE.

Goniothalamus rotundisepalus, sp. nov.

Frutex 1-2 m. altus. Ramuli glabri, partes juniores ferrugineo-pubescentes. Folia glabra, 14-23 cm. longa, 4.5-8.5 cm. lata, oblonga vel elliptico-oblonga, acuminata, base acuta, nervis utrinque

The Bandstand Hill, Singapore Gardens, about 1877.

The Bandstand Hill in 1925.

7-9, supra obscuris, subter tenuibus sed distinctis. Flores axilarii, solitarii, 2.5 cm. longi; sepala rotunda, glabra vel extus sparse ferrugineo-pubescentia, intus glabra; petala exteriora late lanceolato-acuta, 2.5 cm. longa, circa 1 cm. lata, interiora ovata 1.2 cm. longa, 7 mm. lata. Carpella rubro-pubescentia, anguste oblonga, stigmate 2-lobato.

A shrub 1-2 metres high. Branchlets glabrous, dark-coloured, the youngest twigs and buds and very young leaves with a short red pubescence.

Leaves glabrous, 14-23 cms. long, 4.5-8.5 cms. broad, oblong or elliptic oblong, acuminate, narrowed to the base. Nerves 7-9 pairs, faint above, thin but distinct below, interarching far from the leaf margin. Reticulations indistinct.

Flowers solitary, axillary, pale-green, 2.5 cms. long. Bracts 4, ovate-acute, red-pubescent, 2-3 mms. long. Pedicels 4-5 mms. long, slender, with a few red hairs. Sepals orbicular or rotund, glabrous or with sparse red pubescence outside, glabrous inside. Petals leathery, drying black, the outer with a scattered red pubescence on both sides, broadly lanceolate-acute, narrowed to the truncate base, 2.5 cms. long, about 1 cm. broad; the inner ovate, red-pubescent on the outside like the outer petals, but with a denser brownish mealy pubescence inside, which is more pronounced at the cohering edges, and is almost absent at the base, 1.2 cms. long, 7 mms. broad. Stamens numerous, the appendages orbicular, pubescent. Ovaries linear-oblong, red-hairy, style rather stout, with two thick stigmas. Fruit unknown.

Sungai Renong, Kelantan, Md. Nur (with Dr. Foxworthy) 12157, February 1924.

Drepananthus pahangensis, sp. nov.

Arbor circa 3 m. alta. Folia elliptica vel elliptico-oblonga, base inaequilateralia, rotundata vel leviter cordata, acuminata, 17-29 cm. longa, 7-12 cm. lata, nervis utrinque 12-15. Sepala triangulo-acuta, 7 mm. longa et lata. Petala exteriora oblonga, 1.7 cm. longa, 7 mm. lata, interiora conniventia, 1.3 cm. longa. Carpella supra glabra, subter sericeo-pubescentia.

A tree about 3 metres tall. Young branches terete, red-pubescent, lenticellate. Leaves elliptic or elliptic-oblong, broadest near the apex, base inequilateral, rounded or slightly cordate, apex acute, dark brown (when dry) and glabrous above except for the nerves, brown below; 17-29 cms. long, 7-12 cms. broad. Nerves 12-15 pairs, fine on the upper surface and red tomentose like the sunk midrib, prominent below and interarching, sparsely pubescent. Reticulations faint above, prominent and regular below, pubescent like the nerves.

Flowers yellow, one or two on a short woody tubercle. Peduncle stout, up to 2 cms. long (but usually shorter), with ovate-acute bracts up to 5 mms. long, the peduncle and bracts red-hairy. Sepals and petals leathery, pustulose, with a sparse reddish pubescence. Sepals triangular acute, base broad, edges thickened, 7 mms. long and broad. Outer petals oblong, narrowed to the rounded tip, slightly constricted above the claw and arching over the base of the inner petals, but not connivent, the claw glabrous inside, the arch with a yellowish mealy pubescence, edges of limb incurved, 1.7 cms. long, 7 mms. broad. Inner petals connivent similar in shape to the outer, but smaller, strongly constricted above the claw, keeled on the back, 1.3 cms. long. Stamen appendages glabrous, hexagonal. Ovaries glabrous above, silky pubescent below with long yellowish hairs. Fruit unknown.

Pahang: Kuantan, Burn-Murdoch, May 1924; Baloh Forest Reserve, Forest Department 830, March 1919, and 3141, March 1920; Pulau Manis, Forest Department 824, September 1919.

Johore: Gunong Panti, altitude 1000 feet, R. E. Holttum, April 1925. Malay name "Antoi."

BALSAMINACEAE.

Impatiens Foxworthyi, sp. nov.

Herba reptans succulenta, 20-30 cm. alta, glabra. Folia petiolis ad 9.5 cm. longis, 6.5-8 cm. longa, 4.5-6 cm. lata, ovata, mucronata, margine denticulata. Inflorescentiae ad 20 cm. longae, pedicellis bracteatis. Sepala latiora ovato-rotundata, 5 mm. longa, 4-5 mm. lata, interiora parva, linearia, 4 mm. longa. Labelli limbus amplus, calcar robustum, incurvatum; vexillum ovatum, 8 mm. longum. apice mucronato; alae 1 cm. longae, sessiles, bilobae. Filamenta brevia; antherae oblongae.

A creeping and ascending succulent herb, 20-30 cms. high, glabrous. Leaves 6.5-8 cms. long, 4.5-6 cms. broad, crowded towards the top of the stem, ovate, thin, the margin with small spinulose teeth, the apex mucronate, the base narrowed and decurrent on the petiole. Petioles variable in length from 1.5 to 9.5 cms.

Inflorescences axillary or subterminal, peduncles glabrous, succulent, branched once, up to 20 cms. long. Flowers crowded towards the ends of the branches, the fallen ones leaving prominent scars. Bracts similar to the sepals, but slightly smaller, conspicuous and persistent. Pedicels slender, up to 1 cm. long.

Flowers yellow. Sepals 5, the laterals 5 mms. long, 4.5 mms. broad, ovate-rotund, oblique, slightly keeled, notched at the top with a thick blunt mucro in the notch; the inners narrow, linear, broadened at the base, 4 mms. long; the posterior sepal large, 1.5

cms. long and about 1 cm. across the mouth, the limb triangular with a short thick blunt point at the mouth, the spur stout, incurved, about as long as the limb. Petals: the vexillum ovate, 8 mms. long and 4 mms. broad, the keel prominent at the base and produced at the notched tip into a triangular point; the wings 1 cm. long and 8 mms. broad, sessile, two-lobed, the lobes rounded and nearly equal, the dorsal spur prominent, slightly down-curved. Stamens cohering, filaments short, anthers oblong. Fruit unknown.

On limestone rocks at Gua Kechapi on the Pahang-Kelantan boundary, Md. Nur (with Dr. Foxworthy) 11912, February, 1924.

OLACACEAE.

Phytocrene trichura, *Ridl., Flor. Malay Pen., Vol. II., p. 433.*

This plant was first collected by Mr. Ridley in the Ulu Batang Padang, Perak, in 1909, and was not again obtained until June 1923 at Lubok Tamang, Pahang, on the Bertam River. Mr. Ridley could not procure leaves, owing to the height to which the plant climbed, and described it from inflorescences only. The following is a short description of the leaves:—

Stem longitudinally wrinkled, red hairy. Leaves ovate cordate, deeply three-lobed, the lobes acuminate, the terminal lobe long and broad. Upper surface rough with greenish pubescence on the main nerves and sparse reddish hairs on the faint raised reticulations; nerves and reticulations below with bristly reddish hairs. Nerves three from the base, the main nerves and reticulations elevate and bold beneath: 12-15 cms. long, 10-11 cms. broad. Petiole roughly hairy, 4.5-5 cms. long.

Lubok Tamang, Pahang, altitude 3500 feet, June 1923. Coll: M. R. Henderson, F. M. S. Museums No. 10928.

SCROPHULARIACEAE.

Herpestis floribunda, *R. Br.* Bacopa floribunda, *Wettst.*

Not previously recorded from the Malay Peninsula. Collected in padi-fields at Padang Lerang, Kuala Trengganu, by R. E. Holttum, no. 17353, May 1925.

Distribution:—India to Australia.

ASCLEPIADACEAE.

Dischidia Fultonii, sp. nov.

Herba epiphytica. Folia carnulosa, exsiccata coriacea, ovata vel ovato-lanceolata, acuta, glabra, 1.5-1.9 cm. longa, 7 mm. 1.2

cm. lata, nervis obscuris. Pedicelli ad 1.5 mm. longi, crassi. Sepala membranacea, ovata, obtusa, 1 mm. longa, squamis minutissimis. Corolla alba, lobis rubicundis; tubus urceolus, 4 mm. longus. Coronae lobi erecti, membranacei, lobis recurvatis, acutis. Folliculi 5 cm. longi, glabri.

A slender trailing or pendent epiphyte. Stems slender, pale below and minutely papillose, dark brown above, longitudinally wrinkled when dry. Leaves fleshy, coriaceous when dry, ovate or ovate-lanceolate, acute, glabrous, edges not recurved, both surfaces irregularly wrinkled when dry, 1.5-1.9 cms. long, 7 mms.—1.2 cms. broad. Nerves quite invisible. Petiole stout, 4 mms. long.

Umbels about 5-flowered on thick tubercled and bracteate rachises which are either supported on peduncles 2.5-3.5 cms. long, minutely papillose and longitudinally wrinkled like the stem, or are sessile in the leaf axils. Pedicels stout, up to 1.5 mms. long. Calyx lobes membranous, ovate obtuse, 1 mm. long. Scales very minute. Corolla white tipped with pink, tube urceolate, 4 mms. long, globose below, contracted at the mouth, glabrous except for the inside of the lobes, which are densely hairy. Corona erect, large, the lobes membranous, broadly anchor shaped, the recurved arms of the lobes long, acute.

Follicle 5 cms. long, glabrous, linear acuminate, slightly curved.

Johore: Gunong Belumut, altitude 3000 feet, R. E. Holttum 10727, May 1923.

GESNERACEAE.

Didymocarpus lancifolia, sp. nov.

Herba 10-13 cm. alta. Folia petiolis 5 mm. longis, lanceolata, 2.8-3 cm. longa, 8 mm.-1 cm. lata, supra sparse pilosa, subter nervis densissime pilosis. Pedunculi 1-floriferi, 2.6 cm. longi, rufi, pubescentes. Sepala linearia, lanceolata, pilosa, 2.5 mm. longa. Corolla alba; tubus cylindricus, superne dilatatus, 2 cm. longus; lobi rotundati. Stamina 2, filamenta 5 mm. longa. Ovarium cum stylo et stigmate pubescens.

A creeping and ascending herb, stem woody, hispid, 10-13 cms. tall. Lower part of the stem leafless, the leaves crowded towards the top. Leaves lanceolate, 2.8-3 cms. long, 8 mms.-1 cm. broad, narrowed to the apex and base, the upper surface sparsely covered with long soft hairs, becoming more dense on the edge, the lower surface densely hairy on the nerves. Nerves 4-6 pairs distinct below. Petioles hispid, 5 mms. long.

Peduncle one-flowered, 2.6 cms. long, red-coloured, pubescent; pedicel 6 mms. long. Calyx lobes 5, linear lanceolate, hairy, 2.5 mms. long. Corolla narrow, cylindric, dilated at the top, 2 cms.

long, slightly pubescent outside, lobes rounded; white, with two brown lines on the lower lip and a tinge of mauve round them. Stamens inserted one-third of the way down the corolla tube, filaments 5 mms. long, rather thick. No trace of staminodes. Disc conspicuous, one-sided, slightly lobed. Ovary, style and stigma all pubescent, the style reaching to the anthers, the stigma large, capitate. Fruit unknown.

Pahang: Gorge of the Sungai Tras near Raub, altitude 500 feet, I. H. Burkill and Md. Haniff 16946, November 1924.

Loxocarpus papillosa, sp. nov.

Folia petiolis 1 cm. longis, obovata vel obcuneata, 6-11 cm. longa, 2.5-a cm. lata, apice et base rotundata, nervis utrinque 10-12. Pedunculi 1-floriferi, 3.5-6.5 cm. longi. Sepala linearioblonga, pubescentia. Corolla coerulea, 5 mm. longa, leviter pubescens; tubus campanulatus, lobis oblongis, rotundatis. Stamina 5, filamentia brevia et crassa; antherae rotundatae, conniventes. Ovarium cum stylo pubescens. Capsula 7-9 mm. longa.

A stemless herb with the leaves in a rosette. Leaves obovate or obcuneate, apex rounded, base rounded and sometimes inequilateral, 6-11 cms. long, 2.5-4 cms. broad, the midrib, nerves and occasionally the intervening spaces on the upper surface with long hairs, which form a more or less uniform covering on the lower surface and on the margin. Nerves 10-12 pairs, thin but distinct on the lower surface, regular and parallel. Petiole densely hairy, 1 cm. long.

Scapes slender, reddish, pubescent, pale and glabrous when older, 3.5-6.5 cms. long, one-flowered. Sepals linear oblong, pubescent. Corolla pale blue, 5 mms. long, slightly pubescent, the tube wide, campanulate, lobes oblong, rounded, rather deep. Stamen filaments short, thick, the anthers round, peltate, connivent. No staminodes. Ovary and style pubescent, the style as long as the corolla tube. Stigma small, capitate. Capsule 7-9 mms. long, red pubescent, narrowly conic, straight, splitting along the upper edge, the style persistent. Seeds narrowly elliptic, reticulate.

Negri Sembilan: North side of Gunong Angsi, altitude 2600 feet, Md. Nur 11632, November 1923. Gunong Angsi, altitude about 2000 feet, R. E. Holttum 9923, December 1922.

Paraboea Holttumi, sp. nov.

Herba erecta. Folia petilolis 1.5-3 cm. longis, 8-11 cm. longa, 1.5-2 cm. lata, lanceolata, nervis obscuris. Pedunculi circa 5.5 cm. longi; bractae angustae, 3 mm. longae. Calycis sepala linearilanceolata, hispida, 3.5 mm. longa. Corolla campanulata, circa 1.2

cm. longa, extus pubescens. Filamenta crassa; antherae magnae, triangulae, conniventes. Ovarium cum stylo ferrugineo-piloso-um; stigma capitatum.

A herb with a stiff habit, about a foot tall. Stems woody, terete and glabrous below, above 4-angled and channelled. Leaves 8-11 cms. long, 1.5-2 cms. broad, in distant pairs, lanceolate, narrowed to both ends, texture thick, nerves invisible; the upper surface minutely papillose with scattered white multicellular hairs, more numerous on the young leaves and towards the margin, where they form a regular row; the lower surface rugulose, the hairs, which are similar to those on the upper surface, with a reddish tinge. In life the leaves are dark green above and dark purplish below, and this latter colour persists after drying as a reddish tinge. Petioles 1.5-3 cms. long, the younger ones with a few hairs.

Peduncle sparsely pubescent at base, more densely so towards the apex, about 5.5 cms. long. Branches short with 3 or 4 flowers on each. Bracts narrow, about 3 mms. long. Calyx tube very short, lobes linear lanceolate, hairy, 3.5 mms. long. Corolla campanulate, about 1.2 cms. long, pubescent outside, slightly two-lipped. Filaments rather long, thick, glabrous except at their point of insertion on the corolla, where they are covered with white hairs. Anthers large, connivent, triangular. Ovary and style red-hairy, stigma capitate. Flowers in bud pale yellow. Fruit unknown.

Johore: Gunong Belumut, altitude 3000 feet, R. E. Holttum 10685, May 1923.

This species is near P. campanulata, *Ridl.*, but differs in the thicker and narrower leaves, the narrower corolla, and the longer filaments of the stamens.

ACANTHACEAE.

Hemigraphis Ridleyi, *Clarke,* var. nervosa, n. var.

This variety differs from typical H. Ridleyi in the smaller leaves (3 cms. long and 2 cms. broad), which are broad at the base with a tendency to become cordate, and not cuneate; in the increased pubescence on both surfaces of the leaves, and the absence of rhaphides; and in the more conspicuous and elevated nerves and reticulations. The flowers are as in *Ridleyi*, except that the bracts are longer (1-1.5 cms. long) and also the calyx lobes (6 mms. long).

Pahang: Railway banks at Kuala Lipis, I. H. Burkill and Md. Haniff 15699, November 1924.

LORANTHACEAE.

Loranthus pekanensis, sp. nov.

Frutex parasiticus, ramulis glabris teretibus. Folia petiolis 1.5-2 cm. longis glabra, coriacea, ovata, apice rotundata, base cuneata, 9-10 cm. longa, 6-6.5 cm. lata; costa subter prominens; nervi laterales utrinque 3 vel 4. Flores 20-30 in fasciculis axillariis; pedicelli 4 mm. longi. Calycis tubus 4 mm. longus, urceolatus, limbo minuto denticulato. Corollae tubus 1.3-1.6 cm. longus, luteo-flavus; lobi 5, reflexi, viridi; Stamina 5. Fructus ignotus.

A shrub parasitic on Vitex sp. Branchlets glabrous, stout, terete, the youngest reddish brown, the lower greyish brown, lenticellate. Leaves glabrous, reddish brown when dry, in whorls of three or four, stiffly coriaceous, ovate, rounded at tip, narrowed to the base, 9-10 cms. long, 6-6.5 cms. broad. Nerves 3 or 4 pairs, just visible when dry, slightly more prominent on the upper surface than on the lower, the midrib prominent and elevate below.

Flowers glabrous except for a very fine white pubescence on the inside of the petals; in axillary fascicles of 20 to 30 on the thickened nodes. Pedicels 4 mms. long. Calyx urceolate, minutely toothed, 4 mms. long. Corolla orange-yellow, tipped with green, gamopetalous, of 5 segments, the tips of the petals reflexed, 1.3-1.6 cms. long. Stamens 5 included, style very shortly exsert. Fruit unknown.

Pahang: Pekan, I. H. Burkill and Md. Haniff 17104, November 1924.

ZINGIBERACEAE.

Alpinia Burkillii, sp. nov.

Caulis ad 2 m. altus. Folia 69 cm. longa, 10-13 cm. lata, oblonga-lanceolata, cuspidata, utrinque pubescentia; ligula 6-7 mm. longa, bifida, margine pilosa. Panicula 20-30 cm. longa; calyx circa 1.4 cm. longus, cylindricus, trilobatus; corollae tubus 1.4 cm. longus, pubescens; petala 2 cm. longa, ovato-lanceolata, extra pilosa; labellum amplum, glabrum, 2.7-3 cm. longum, 3 cm. latum. Staminodia magna, bilobata. Stamen glabrum, connectivi appendicula brevis. Capsula globosa, puberula, 2 cm. diametro.

A herbaceous plant about five feet tall. Leaves oblong lanceolate, long cuspidate, pubescent above with long regularly spaced hairs with swollen bases, softly pubescent below, 69 cms. long, 10-13 cms. broad. Petiole 2-2.5 cms. long pubescent. Ligule 6-7 mms. long, bifid, lobes rounded, long hairy on their edges. Panicle 20-30 cms. long, with a narrow pubescent sheath as long, branches 1.5-2 cms. long, all velvety pubescent. Bracts glabrous,

papery, ovate, enclosing 4 to 7 flowers on pubescent pedicels 1.5 cms. long.

Calyx cylindric, 3-lobed, rather longer than the corolla tube, glabrous except for the pubescent tips of the lobes. Corolla tube 1.4 cms. long, pubescent, with a ring of long hairs at the base. Petals 2 cms. long, ovate lanceolate, blunt, hairy on the back, the upper lobe hooded and with a conspicuous spur. Lip large, quite glabrous, 2.7-3 cms. long, 3 cms. broad; side-lobes rounded, mid-lobe bifid, the lobes truncate; margin of lip cripped; two patches of claret colour on the side lobes not reaching the margin, and a number of violet-black lines in the centre of the lip above the mid-lobe. Staminodes two, conspicuous, bilobed, adnate to the base of the stamen and lip. Stamen glabrous, the connective prolonged into a short crest.

Capsule globose, puberulous, about 2 cms. in diameter and crowned by the persistent calyx.

Negri Sembilan: Gemas, I. H. Burkill 4980, August 1919.

Pahang: 126th. mile, Kuantan Road, between Sungai Lepar and Sungai Ketam, and at Sungai Luit, I. H. Burkill and Md. Haniff 17210, 17461, November 1924.

A New Fern from the Malay Peninsula.

Syngramma minima, *Holttum* sp. nov.

Rhizoma repens, tenue, pilis nigris nitidis vestitum. Stipites approximati, 5—15 mm. longi. Frondes rigidae, in sicco fragiles, glabrae, 1—4 cm. longae, 5—8 mm. latae, obovatae vel oblanceolatae, apice rotundatae, basin versus sensim angustatae, margine cartilagineae denticulatae. Costa utrinque vix prominens: venae simplices vel furcatae, liberae vel sub margine anastomosantes, fere obscurae. Sori 1-2 mm. longi, ad venas terminales.

Gunong Panti, Johore, Holttum 17498.

This small fern grows side by side with *S. borneensis* on sandstone rocks at the top of the ridge of G. Panti, at an altitude of about 1600 feet above sea. It somewhat resembles the young plants of *S. borneensis*, but is distinguished clearly from its earliest stages by the shape of its leaves and by its less densely tufted habit. The shorter leaves are often quite as broad as the longer ones, and leaves hardly more than 1 cm. in length may be fertile. The leaves on young plants are more deeply toothed than those produced later. The species is allied to *S. Dayi*, but has much shorter and broader

Dipteris Lobbiana, near Gunong Pulai, Johore.

leaves: *S. Dayi* also lacks the toothed cartilaginous edge. It is curious that both *S. minima* and young plants of *S. borneensis* on G. Panti are parasitised by a scale insect, such being uncommon on wild ferns in this country.

Notes on Malayan Ferns

1. Dipteris Lobbiana.

This interesting fern has a wide distribution in Malaysia and is quite abundant, at least over part of its range, but probably because of its peculiar habitat it was not often found by the earlier collectors. In Christ's *Farnkräuter der Erde* (1897) it is said to be a rare plant. Its collection on Mount Ophir by Lobb, together with *Matonia pectinata*, with which it probably has a common ancestry, has associated the names of the two ferns together, though in nature they do not grow side by side. *Matonia pectinata* is found on the exposed summits of a number of the highest mountains in the Malay Peninsula and at lower altitudes on some of the small islands to the south of it; *Dipteris Lobbiana* is found only on rocks by the sides of forest streams, often quite in the low country. It has been found plentifully by several streams in Johore, as well as on Mount Ophir, and also further north in Pahang (Tahan River and Sungei Perting, Bentong), in Perak (abundantly in the Palas River on Gunong Bujong Malacca, and at other localities not specified) and as far north as Kedah Peak. In Borneo Bishop Hose has stated that it is found "on the banks of most rivers in Sarawak and North Borneo at some distance above the highest point to which the influence of the tide extends." van Alderwerelt van Rosenburgh gives the distribution "Malaya," a term to which he attaches a wide meaning. Copeland records it as occurring in Celebes, but the writer has seen no published record of its occurrence in Sumatra or Java, though the former is not unlikely. It is not found in the Philippines.

The present writer has seen this fern three times, on all occasions in Johore; by the Sungei Berhidong, north of Gunong Belumut, at about 450 feet above sea level, by one of the streams flowing southwards from Gunong Pulai (see accompanying plate), at a similar altitude, and in the Pelepah valley near Kota Tinggi. In descending the first-named stream from about 1600 ft., Dipteris was not observed in the steeper more shaded upper reaches, but appeared where the course became more level and open. The beds of all three streams are filled with granite boulders of greatly varying size; the fern grows over the boulders, its rhizomes clinging tightly to them. Sometimes by the side of the stream the boulders are covered with sand or silt, and in this case the rhizome is not

exposed; in such positions, on the edge of the jungle beside the stream, the fronds reach their largest size. The plant grows everywhere quite close to the water, sometimes on rocks in mid-stream, and it is evident that at times of flood the fronds are quite submerged. After heavy rain (which may occur at almost any time of year) such streams rise rapidly to a height considerably above their normal level. Burkill remarks of Dipteris Lobbiana at Bentong that "the tenacity with which it holds on to the rocks is remarkable. It grows in places where the floods must often submerge it" (note on field label). The division of the frond into narrow segments is undoubtedly of great service under such conditions; it could hardly survive if it had the broad lamina of *D. conjugata*. Further, the narrow coriaceous leaflets are a xerophytic character probably connected which the fact that the fern often grows exposed to the sun, and may be left with a restricted water supply when the stream is low.

Another fern growing under the same conditions is *Meniscium salicifolium* Wall. (*Dryopteris* C. Chr.). Its narrow entire coriaceous leaflets are quite comparable with those of *Dipteris Lobbiana*, though it has pinnate leaves and a short rhizome instead of a long creeping one. It has the same kind of relation to the broad leaved *M. cuspidatum* Bl. (which has a wider distribution) as *D. Lobbiana* has to *D. conjugata*. A third species, which is almost certainly of the same habitat, is *Aspidium semibipinnatum* Wall., from the south of the Malay Peninsula and Borneo. It has narrow ribbon-like leaflets in contrast to the broad pinnae of its allies which live in the shade of the jungle. These ferns are undoubtedly specialised to the stream bed habitat, and are not found elsewhere.

Borneo appears to be the centre of distribution of the genus Dipteris as it exists today, and has two peculiar species. One of these, *D. quinquefurcata* (Bak.), is very close to *D. Lobbiana;* in fact, the writer is disposed to doubt whether it is a distinct species. On the banks of the Pelepah stream above mentioned, somewhat in the shade of the edge of the jungle, were some very large fronds of *D. Lobbiana*, twice as big as many of those on the rocks in the stream bed. In these there is a very marked tendency for the sori to break up into as many as five or six smaller ones in a single areola, and the segments of the fronds reach 9 cm. in width. This condition is almost that described for *D. quinquefurcata*, and it is quite possible that the latter species, known from few specimens with little or nothing in the way of field notes, only represents an unusually large form of *D. Lobbiana*, grown under unusually favourable conditions.

Bower has suggested *Land Flora* (1908) pp. 618-622, *The Ferns* (1923) p. 226) that *D. Lobbiana* is the most primitive

member of the genus, most nearly allied to the ancestral Matonia-Gleichenia type. Its simple narrow divisions with a single row of rather large sori on either side of the midrib, and the fact that all sporangia in a sorus are produced simultaneously whereas the sorus of *D. conjugata* is "mixed," all point to a relatively primitive condition. At the same time it is rather remarkable that *D. Lobbiana* is so well adapted to the conditions of the peculiar habitat in which alone it appears capable of living in nature. One must suppose that it is derived from an ancient type, and has retained its primitive characters on account of their suitability to its environment. It is evidently unable to grow either in the shade of the jungle or on exposed ground away from streams; in the latter position it would be crowded out by more vigorous competitors. *D. conjugata*, on the other hand, may be regarded as a more recent and vigorous type, capable of holding its own under conditions in which it has far more competitors; it has a correspondingly wider range of distribution.

2. On the production of fertile fronds by Stenochlaena palustris.

Stenochlaena palustris (Burm.) Bedd is a fern of wide distribution in the eastern tropics, extending from northern India and southern China through the Malayan region to Australia and into the Pacific. In Singapore it is one of the commonest ferns, especially in somewhat moist places, being frequent by roadside ditches. It will flourish with its fronds fully exposed to the sun and its stems trail long distances over the ground or climb high up tree trunks. The young fronds are tender, and are edible, but the old ones are very stiff and leathery. Usually only the sterile leaves are produced, but from time to time the narrow fertile leaves may be observed, occasionally in large numbers.

The question arises as to what are the factors determining the development of the fertile fronds. Over part, probably most, of its range, this fern is subjected to a more or less prolonged dry season. I can find no records of its behaviour under such circumstances, but it seems probable that fertile fronds are produced during the dry season, and sterile fronds only or chiefly during the wet season. Where there is a dimorphism between the sterile and fertile leaves of terrestrial ferns it is usual for the fertile to have a more or less contracted lamina, and a longer stipe, thus exposing the sporangia to a drier air than is found close to the ground, and also guarding to some extent against the consequent greater transpiration (see Copeland E. B., on the comparative ecology of the San Ramon Polypodiaceae, *Philippine Journal of Science*, C., Vol. 2, pp. 59-61). Stenochlaena is not essentially terrestrial, and the dimorphism is here connected most probably with a drier season, not with a drier stratum of the

atmosphere. However, there appears to be a response to the greater dryness of the air away from the ground in the production of a greater number of fertile fronds on those stems which have climbed up tree trunks; but fertile fronds are not confined to such situations, being found on the ground also.

In Singapore we have such a uniform climate that this fern has not any definite seasonal stimulus to the production of fertile fronds. The most marked wet season is usually that of the north-east monsoon, about November to January; there is usually hardly so marked a dry season, and therefore what must be supposed to be the stimulus of change from wet to dry is not often a strong one. Probably any fairly pronounced dry period will initiate the production of fertile fronds, and a very wet period a crop of sterile ones.

From the few observations I have made in Singapore it seems probable that a period of about twelve days or more with little or no rain is sufficient to induce the production of fertile fronds on some at least of the plants of this species. The position of the plant has no doubt some influence on the matter. By the time the fronds have developed the weather may be wet again. The fertility of a frond must be determined at a very early stage, while it is still coiled up in its bud, covered by overlapping dark coloured orbicular scales. I have not been able to determine exactly at what stage the form of the fronds is determined; I have only observed the production of fertile fronds on certain plants constantly under notice, and have examined the rainfall records of the preceding few weeks.

My attention was first called very strikingly to this matter in March 1923. After the wet and cloudy weather of the N. E. monsoon there came an unusually prolonged drought. From Jan. 24 to Feb. 17 there was only .4 in. of rain, nearly all of which fell on one day; on Feb. 18 there fell 1.28 in.; from Feb. 19 to March 13 only 1.7 in. During March and April there was a great abundance of fertile fronds of *Stenochlaena palustris* in the Gardens, and also on some plants outside which I happened to notice. There was a less pronounced dry period from August to October, and again abundant fertile fronds, but I have no particular observations.

1924 was much wetter than 1923, and fertile fronds were fewer. The following are observations of their appearance: March 10; a few young fertile fronds observed. The second half of February had been dry, (.88 in.) after an excessively wet first half (14.7 in.). Early June; fertile fronds on several plants. There had been a dry period from April 26 to May 7 (.21 in.)

August 18; fertile fronds on several plants. The period July 14 to 26 had been dry (.10 in.).

Feb. 1, 1925; 16 fertile fronds on one plant, and many on other plants also. The period Dec. 23 to Jan. 4 had been dry, eight of these days being quite rainless, and a period of seven days having only .10 in. of rain. January was very wet, and on Feb. 10th a large number of new sterile fronds were seen unfolding. It is curious that the young sterile fronds are always pink (like the young leaves of many trees), whereas the young fertile fronds are green.

These observations are not very complete, but they appear to be of some interest. It is remarkable how little biological observation is recorded concerning the majority of our ferns; even information as to habitat is usually missing from systematic works. It is only the more remarkable species, such as the Platyceriums, Lecanopteris and Drynaria which have received attention, but there is much of interest to be recorded about species less remarkable from a morphological standpoint.

3. **Gleichenia opposita** v.A.v.R.

In various places on the lower slopes of the hills of Penang a peculiar Gleichenia is abundant. There are two old specimens in the Singapore Herbarium, collected by Curtis (no. 534, fertile) and Ridley (7037), and another has been added by the present writer (10286). It has recently been observed fairly abundant on the lower slopes of Kedah Peak, and was also collected at Semenyih in Selangor by H. L. Hume in 1922 (F. M. S. Museums no. 8327).

Mr. H. N. Ridley in his recent paper on the ferns of the Malay Peninsula (Journ. Malayan Branch, R. Asiatic Society, Vol. 4, p. 3) has described it as a new species, *G. parallela*. I find however that the type collection of *G. opposita* v.A.v.R. from Sumatra (which I have examined, by courtesy of the Curator of the Buitenzorg Herbarium) is identical, so that the latter name must be adopted (Bull. Jard. Bot. Buitenzorg, Series 2, XI, 13. 1913). The species is one of considerable interest, and as it appears to me that both the descriptions above mentioned are somewhat inadequate I have prepared the following notes on it. In dealing with the fronds of *G. linearis* and its allies with their manyfold forking (with or without development of the included buds) the usual terminology of pinna and pinnula becomes a little difficult to apply. For convenience I have here regarded each leaf as a branch system and have adopted the term pinna only for the ultimate leafy branchlets.

The main lateral branches of the fronds of this fern appear at first sight to be regularly bipinnate, with opposite pairs of pinnae, something like a form of *G. glauca* with the pinnulae (in the strict sense) opposite and widely spaced. A closer examination shows that a bud is present in the axil of one pinna of each pair,

on alternate sides of the rachis, and that the pinnae subtending these buds are larger than those opposite. The pinnae have exactly the same form as the ultimate branches of some forms of *G. linearis;* the pinnulae are closely set and densely ferruginous-hairy beneath, especially on the costulae. Comparing the branching of this fern with that of typical *G. linearis*, the homologies of the various parts are obvious. The axils where buds are present really represent forkings of the rachis, the forking being here unequal; one branch continues the growth of the branch-system, while the other is leafy like the ultimate branches of *G. linearis*. The opposite smaller "pinna" is one of the accessory branches usually present at the forkings of *G. linearis*, the other one being suppressed.

This condition of the apparent existence of two opposite pinnae is frequently found in the commonest of the smaller forms of *G. linearis* occurring in the Malay Peninsula. Fig. 1 shows diagrammatically the typical symmetrical branching of the common large form, fig. 2 a frequent type of branching in the small form just mentioned (which is very irregular) and fig. 3 the branching of *G. opposita*. In fig. 2 it is seen that at the penultimate forking the pseudopinnate condition occurs; it may also occur lower down the branch-system, though less frequently. Sometimes there is some development of the suppressed accessory branch, which may be represented merely by a rather long and slightly lobed pinnule.

On examining a number of complete fronds of *G. opposita* it is found that various irregularities in its branching may occur, and that these are all tending to the condition of the variety shown in fig. 2. The principal irregularities are as follows. Two of them are indicated in fig. 4.

(1). The suppressed accessory branch at any forking may be developed, either in a rudimentary form, or more rarely of normal size. These rudimentary accessory branches are common in other forms of *G. linearis,* as mentioned above.

(2). At any forking the smaller branch may be again forked instead of simple, with or without development of the extra accessory branch.

(3) The bud in any fork may develop, forming a short branch, forking once or twice again. At these subsidiary forkings small accessory branches may be developed.

(4). It not infrequently happens that the lowest bud on the lateral branch-system of a large frond develops into a strong axis, only slightly less in size than the main axis, bearing at its forkings lateral branch-systems exactly like those of the main axis, though somewhat smaller. In the branch systems of these subsidiary axes I have observed the same irregularities as those of the branch-systems of the main axis just described.

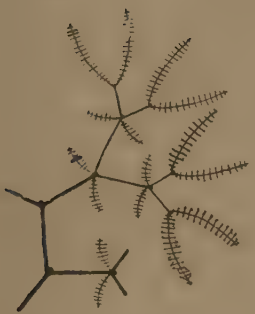


Fig. 1. Branching of normal G. linearis.

Fig. 2. Branching of a common form of G. linearis.

Fig. 3. Branching of G. opposita.

Fig. 4. Two abnormalities observed in. G. opposita.

These irregularities all point to a close relationship with *G. linearis;* further, the fertile fronds show an arrangement of sporangia agreeing with *G. linearis*, 12 to 20 sporangia being present in each sorus.

4. Syngramma borneensis and Lindsaya borneensis in the Malay Peninsula.

On a recent visit to Gunong Panti, in the south-east of Johore, I found *Syngramma borneensis* (Hk.) J. Sm. and *Lindsaya borneensis* Hk. quite abundant in the low forest on the top of the sharp ridge which forms the hill. The altitude is about 1530 feet above sea. *Syngramma borneensis* grew on the ground, and also in rock crevices. Most of the plants bore fertile fronds, which were decidedly longer and narrower than the sterile ones. The species has not previously been recorded from the Malay Peninsula, but two specimens from Mt. Ophir collected by Mr. Ridley (3334 and 9079) have been found in the Singapore Herbarium. Mr. Ridley, in his paper on the ferns of the Malay Peninsula (*Journ. Malayan Branch, R. Asiatic Soc.*, Vol. 4, p. 111) appears to refer these specimens to *Elaphoglossum melanostictum*, but they are evidently to be referred here, though they are large (fertile fronds to 60 cm. long).

Lindsaya borneensis is otherwise represented in the Singapore Herbarium only by two specimens from Singapore Island, though Beddome records it as collected by Scortechini in Perak. Mr. Ridley's 3062 from Taiping Hills and 12132 from G. Pulai, which he records as this species, have much larger leaflets and are to be referred to *L. lancea;* his specimen from the Tahan River has not been found here.

5. Syngramma Dayi.

Syngramma Dayi Bedd. is a very small species first collected by Day, on quartz rocks "on the pass between Kuala Kangsar and Kinta, 2000 ft. alt." The exact position of this locality is a little doubtful. The species has now been collected again on Klang Gates (by H. L. Hume, F. M. S. Museums no. 7149). Klang Gates is a ridge of quartzite in Selangor, the highest point of which is about 1400 feet above sea level. On its upper slopes grow many interesting xerophytic plants, a list of which is given by Mr. H. N. Ridley in the F. M. S. Museums Journal, Vol. 10, pp. 247-251 (1922). Mr. Ridley also records *S. Dayi* from Kanching, Selangor, in his recent paper of the ferns of the Malay Peninsula.

6. Lindsaya lancea and L. scandens.

Lindsaya lancea (L.) is a species of wide distribution in the tropics of both the old world and the new, while *L. scandens* Hk.

is recorded as confined to the Malayan region. The distinction between the two is sharp enough if extreme forms be considered; the one terrestrial with compound fronds, the other climbing with simple fronds. But if a large series be examined, it becomes impossible to recognise a distinction between them, and I think that *L. scandens* is a habit-form of *L. lancea*.

Climbing plants may be found bearing unbranched leaves typical of *L. scandens*, and (on the same stem) branched leaves which cannot be distinguished from leaves borne by terrestrial plants with short creeping stems. The terrestrial plants may have fronds with few branches and large pinnules, or many branches and smaller pinnules, and no line can be drawn separating them. The pinnules may have a slightly recurved lower edge, especially if large, or a straight one, in both scandent and creeping forms. The stems of both forms have exactly the same type of stiff dark brown lanceolate scales; but it is to be noted that the scales of *L. repens* are quite similar, so that scales are not to be relied on as specific characters in this genus. The roots on climbing stems are short and serve partly to attach the stem to its support; they are densely covered with root hairs. The roots of terrestrial stems are longer and stouter, and usually have lost their hairs in herbarium specimens, but types more or less intermediate may be found.

van Alderwerelt van Rosenburg says of *L. lancea* in the Supplement to his Handbook of Malayan Ferns (p. 506): "Variable, with the rhizome varying from short creeping to wide scandent, the stipes stramineous to black or purple brown, the fronds to 50 cm. long, the branches abruptly shortly acuminate to subcaudate, the leaflets 1½-3½ cm. long, pale to dark when dry." Admitting so much variation, I cannot see that it is possible to separate *L. scandens* as a distinct species.

We have here an instance of the variability of many fern species; it is shown by several of the Lindsayas. The only real test proving the specific identity of the various form would be to grow plants from spores borne on one frond, and try to produce all the growth forms from the same parent. I do not think that any one has attempted this task, at any rate with Malayan ferns. It has many difficulties, the chief of which is to exclude foreign spores from the experiment.

7. **Polypodium triangulare** Scort.

Polypodium triangulare Scort. was first found in Perak, and described and figured by Beddome in the Journal of Botany, 1887, p. 324, t. 278. There are several specimens collected by Scortechini in the Singapore Herbarium, all without locality, and also specimens collected by Wray (294) at 4500 ft. on Gunong Batu Putch, and Kunstler (Larut 3647). Subsequently it has been found on

G. Kerbau at about 6000 ft. (Haniff 14739) and on G. Tahan at 5500 ft. (Haniff and Nur. 7980). It appeared that the description of Copeland's *Acrosorus exaltata* from the Philippines (Philippine Journal of Science Vol. 1 Suppl. 158) agreed closely with *Polypodium triangulare*, and through the kindness of Mr. E. D. Merrill, lately Director of the Bureau of Science, Manila, I have been enabled to examine a specimen of Copeland's fern. The two appear to be quite identical, and therefore the Philippine plant should be called *P. triangulare*, or *Acrosorus triangularis*, if Copeland's genus be adopted. (See also Phil. Journ. Sci. 3 C, 347).

There are in the Singapore Herbarium specimens of *P. triangulare* collected at Khao Luang in Lower Siam (Dr. E. Smith 725) and on Mt. Kinabalu in British North Borneo (by Major C. M. Enriquez, 18163 in Singapore Series). The species has thus a wide range of distribution in the Malayan region.

8. Gleichenia Norrisii.

This species was described by Kuhn in 1869, apparently from specimens collected by Griffith and Norris some years earlier in the Malay Peninsula. It was figured by Beddome in the Supplement to his *Ferns of British India*, tab. 346. It is closely allied to *G. glauca*, and incomplete herbarium specimens are not always easy to distinguish. When seen in the field, the distinction between the two species is at once apparent. *G. Norrisii* has a looser habit, with more distant pinnulae and broader more rounded segments; the distal pinnulae are also conspicuously bent backwards. It further lacks the long deeply divided stipule-like leaflets that surround the apical buds of the fronds of *G. glauca*, these being replaced by pairs of reduced pinnulae close to the bases of the pinnae which form the fork containing the bud.

In ascending Government Hill, Penang, one first meets *G. Norrisii* at about 1700 feet altitude, where it largely replaces *G. linearis* as the common fern in open places beside the road. It occurs from this altitude upwards to the top of the hill (2500 feet), but towards the top and on the slightly higher Western Hill *G. glauca* appears and is more abundant. *G. Norrisii* has also been found on the Taiping Hills at about 2000 feet (Scortechini 439), on Bukit Panchor in Province Wellesley (Ridley 12654), on G. Angsi at about 2000 feet (Holttum 9901), and at the same height on the top of G. Pulai in Johore (Ridley 12127). *G. glauca* appears to occur at somewhat higher altitudes (to at least 4000 feet) throughout the Peninsula, and has been more frequently collected.

9. Lygodium polystachyum.

Lygodium polystachyum Wall. is by far the most beautiful member of its genus occurring in the Malay Peninsula. It has

rather a restricted range, of which the southern limit appears to be in Upper Perak, though a specimen has been collected by Mr. Ridley at Kuala Tembeling in Pahang. It occurs in Penang and the Langkawi Islands, and Curtis records that it is abundant all over the Island of Puket in Lower Siam. Unlike the other species, it grows in the shade of the jungle, climbing up slender trees, and bears its fertile fronds in the shade. All the other local Lygodiums known to me are sun plants, or if they start life in the shade only flourish produce fertile pinnae in the open. The plants of *L. polystachyum* which have not yet produced climbing leaves have almost the appearance of a *Dryopteris*, and the basal pinnae of all fronds are very large. The texture also is much softer than in the other Lygodiums.

10. **Diplazium Ridleyi** (Copeland).

This species was described (as *Athyrium Ridleyi*) by Copeland in the Philippine Journal of Science, XI c, p. 39. The only distinction from *D. accedens* Bl. is in the presence of sterile areoles between adjacent rows of soriferous veins. Copeland also states that the rachis is smooth. The type collection, Ridley's 13970 from the Telom River, Pahang, is represented in the Singapore herbarium: with it is included a stipe which is covered with blunt spines. Probably no part of the stipe reached Copeland, as he does not mention it. Further, the upper pinnae and the distal portions of the lower ones lack the distinctive phenomenon of the sterile areoles separating the fertile veins. On comparison with other specimens from the Malay Peninsula it is seen that Ridley's Telom plant represents only an extreme form of a variable species. The following specimens all show the additional areoles at least at the bases of the pinnae, though none to such a marked extent as the type of *D. Ridleyi*: Burkill and Holttum 8780, Fraser Hill; Nur. 11083, Fraser Hill; Fox 10657, Maxwell's Hill; E. Smith 1924, Banang Sta, Patani. Considering the known variability of many species of Diplazium, it appears to me that these plants should all be reckoned as *D. accedens* Bl., or *D. proliferum* (Lam.) v. *accedens*.

I have lately seen at Buitenzorg, both in cultivation and in the herbarium, specimens of *D. permirabile* v.A.v.R. (*Bull. Jard. Bot. Buitenzorg*, Ser. 3, Vol. 5, p. 196), and it appears to me that these also should be included in the same species as the specimens above cited. The distinguishing feature of *D. permirabile* is the presence of scales at the apices of the spines on the stipes. The stipes of the herbarium specimens from the Peninsula above mentioned do not show these scales, but the blunt spines are exactly the same as in *D. permirabile*, and the absence of scales is to be ascribed to loss in the processes of drying and mounting. They are more easily lost than ordinary scales growing from the

surface of a stipe. There are plants from the Malay Peninsula in cultivation in the Singapore Gardens which bear scales exactly like those of *D. permirabile*.

11. **Schizoloma Walkerae.**

Schizoloma Walkerae (Hk.) Kuhn has hitherto been collected in the Malay Peninsula only on Mt. Ophir (no altitude recorded) and in Singapore. Mr. Ridley says that it grows in watery places. An additional locality can now be added, in the north of the Peninsula: I found this fern growing on Kedah Peak at an altitude of about 3000 feet above sea, amongst Sphagnum, by a small stream in the low forest.

12. **Dryopteris paleata** Copel.

This species was found on a specimen from Benkoelen in Sumatra. It occurs also in the Malay Peninsula, the other collections having been confused with *D. ferox*, which it resembles only in the extreme scaliness of stipe and rachis. The specimens known from the Malay Peninsula are as follows:

Gunong Angsi (N. Sembilan Holttum 9926, Nur s.n.; Bujong Malacca Ridley 9536; Penang, Ridley 7080, Curtis s.n.: Patani, E. Smith 1856.

The Peninsula specimens are somewhat more hairy than those I have seen from Sumatra. *D. persquamifera* v.A.v.R. from Celebes is closely allied.

13. **Polypodium insigne** Bl.

Beddome records this species from the Malay Peninsula, but cites no specimens; nor do any exist among the older collections represented in the Singapore Herbarium. Two specimens of Mr. Ridley's from Telom are however clearly referable to it: one is numbered 13978, the other unnumbered. They agree well with specimens from Sumatra and from Gunong Gedeh in Java, though somewhat thicker in texture than the latter. This species appears normally to grow on rocks in streams; Mr. Ridley's 13978 is labelled "Telom River," and its appearance suggests a creeping habit.

Two specimens have been collected at Fraser Hill, by Miss G. Hose (no. 9, 1919) and by Burkill and Holttum (8789). The latter was climbing a small tree in the jungle, at about five feet from the ground, and its leaves are thicker in texture than the Telom plants, with narrower segments. These features are probably the consequence of restricted water supply in an unusual habitat.

14. **Hypolepis Brooksiae** v.A.v.R.

This species was described from Benkoelen in Sumatra (Bull. Jard. Bot. Buitenzorg, 2nd Series, XXVIII, 29, 1918), the writer remarking that it resembles *Dennstaedtia scandens* and *D. Moluccana*. It has been collected in the Malay Peninsula at Fraser Hill (Burkill and Holttum 8817, Holttum 11339) and Gunong Bijau (Haniff 9086) and is further represented in the Singapore Herbarium by a specimen from Brastagi in N. Sumatra (Holttum

The larger pond in the Dell, about 1917 (see plan No. 3.)

15435). Bonaparte has referred the specimen first quoted to *Dennstaedtia moluccana* Bl. (Notes Pteridologiques. Fasc. XIV, 55, 1923). I have recently compared the Peninsula specimens with the original in the Buitenzorg Herbarium and find that they agree exactly.

This species grows in tangled masses in open places, and is covered throughout with small thorns; it has apparently the same habit and almost exactly the same appearance as *Dennstaedtia moluccana*. It would be interesting to make a careful comparative study of these species. It seems likely that *Hypolepis Brooksiae* is derived from one of the scandent Dennstaedtias by loss of the inner portion of the indusial cup, the outer part only remaining as a small growth at the base of the sinus below which the sorus is situated. In dried mature fronds it is impossible to detect any trace of the inner side of the cup, but in young fronds it might be found to exist.

It is interesting to observe that *Odontosoris aculata* (L.) from the West Indies appears to have a closely similar appearance and habit of growth.

15. **Polypodium Féei** (Bory) Mett. and **P. heterocarpum** (Bl.) Mett.

There is a common fern in the Malay Peninsula which has usually been called *P. Féei*. On comparing it with specimens of *P. Féei* from Java, and with descriptions, I have come to the conclusion that it should be called *P. heterocarpum*, and that the true *P. Féei* has not yet been found in the Malay Peninsula. The Peninsula fern is often small, the fronds frequently being only 7 to 10 cm. in length; the sori are much broken, rather distant, and distinctly embedded; the rhizome scales are very narrow, almost hair-like. *Polypodium Féei* from Java has usually larger fronds; the sori are much more regular, closer, and not immersed; the rhizome scales are broad. I have seen both plants in the field, and have examined a number of specimens of each in the herbaria at Buitenzorg and Singapore.

R. E. Holttum.

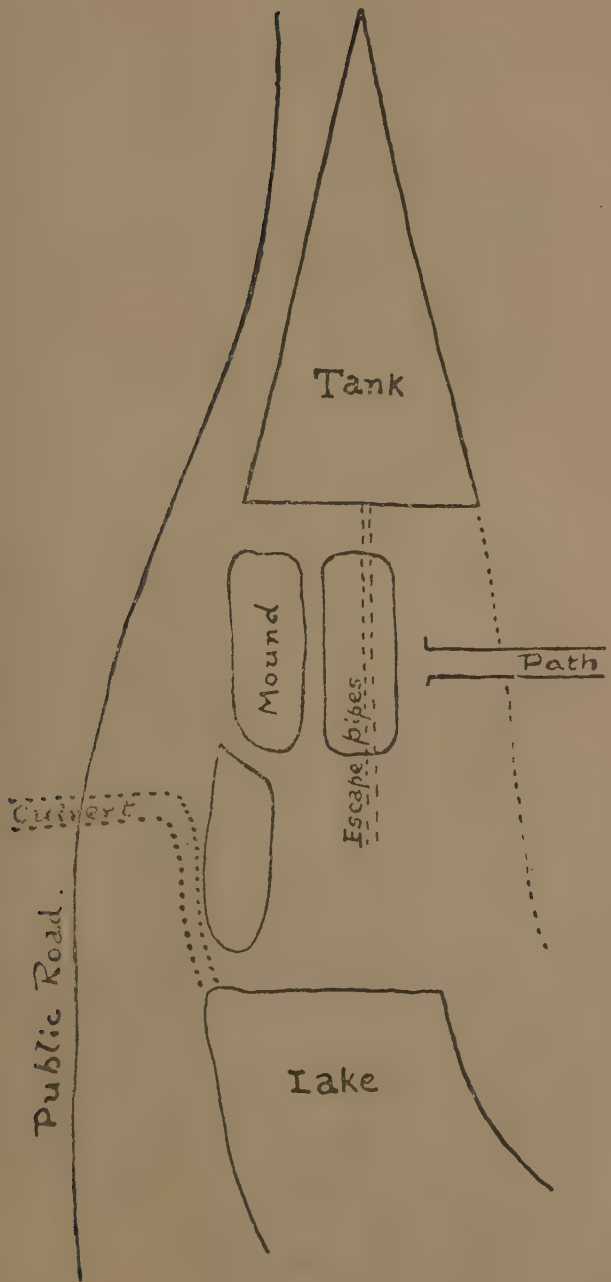
A Note Relating to the History of the Dell in the Gardens

The Botanic Gardens were founded in 1859. In that year the four and a half acres, now occupied by the Gardens Lake, made a swamp, down the middle of which ran the boundary between two properties—on the one side the Kerr property (newly sold to Hoo Ah Kay, better known by his trade name of Whampoa, and then acquired by Government for the Gardens) and on the other, the western side, the Napier property. On the Napier property stood the first house called Tyersal—a house which William Napier had built in 1854 and sold in 1857. When the house was sold the Tyersal property was broken up and went into several different hands, the house which the Temenggong of Johore

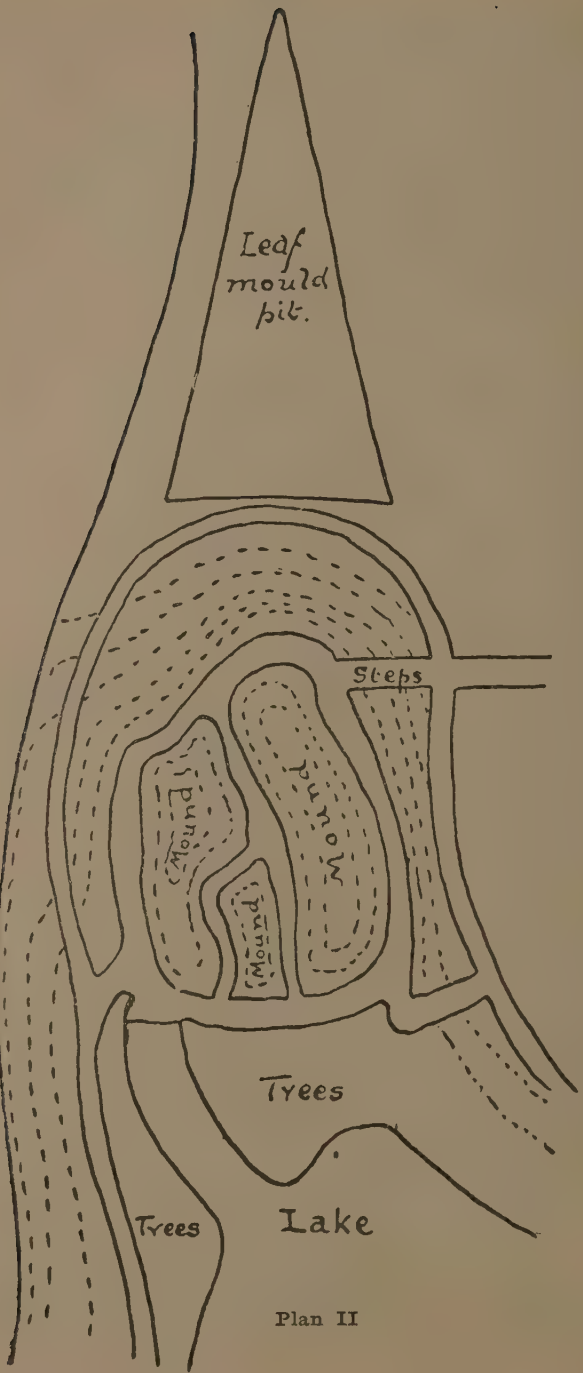
bought carrying with it a little more than sixty-six acres. The Temenggong sold his acquisition again in 1858, but repurchased it on May 23rd 1860. It was he who planted in 1862 the avenue of Tembusu trees (Cyrtophyllum fragrans) which leads to the house from Napier Road. In 1866 there were further deals in parts of the property, during which the Government acquired half of the Avenue together with the strip between the avenue and the swamp. The half of the avenue the Government converted into a public road, i.e. Garden road (now re-named Tyersal Avenue), and the narrow strip they made over to the Agri-horticultural Society for inclusion in the Gardens. The making of the Gardens Lake now became possible; and the Society by erecting a dam some eight feet high, created it.

Garden road is carried across the stream at the head of the Lake on an embankment over a culvert constructed of large rectangular pieces of granite. This culvert possesses a fall of slightly more than two feet in its length and is in section 3 feet 10 inches wide by 2 feet 7 inches high. At the time of its construction the Tyersal lakes did not exist; and, as shown by evidence obtained recently during the draining of them, their site was planted with coconut palms and mangosteens. What stood on the land thrown into the Gardens is quite unknown, as there is not a tree on the strip acquired by the Government, which can have been there in 1866; and there are no records. One may surmise that grass, and perhaps lallang, covered the ground. At the head of the lake, on account of the advantage of the inflow of water from the Tyersal grounds, the Gardens' cooly lines were placed; and a screen of kenari and pomelo trees was planted in front of them. Soon after this the Tyersal lakes were planned in imitation of the Gardens Lake, the imitation extending even to the islet. They were constructed just as the Gardens Lake had been, by deepening the hollow and steepening the banks, the earth from the bottom going in this case to construct a roadway all round the banks. In the extent of this roadway he departed from the model in the Gardens, for in the Gardens the raised road borders the lake only upon one side. The floor of the lower Tyersal lake was arranged to be on a level with the mouth of the Government's culvert, and a sluice was built to control the height of the water above it, whereby if necessary the lakes could be emptied approximately. Under the road along the lake side a culvert, small in section, made connection with the Government's culvert in a sump, and as the bottom of the lower lake was no higher than the entrance to the Government's culvert it was impossible to allow this small culvert to have any fall at all. Under what circumstances the complete emptying of the Lake was anticipated is not known: and there is no evidence that they were at any time emptied.

Emptying was apparently not contemplated in the case of the Gardens Lake, for no sluice existed, and no cutting on the embankment will even at this time completely empty it, as its bottom is still, after all these years of settling, below the level of the drain



Plan I



Plan II

along Napier Road: but there was made an unduly large brick escape channel, 4 feet high, 2½ feet wide, doned and flat bottomed, which functioned for the escape of water till 1922. Only by breaking down its brickwork could this channel be made to carry off about five feet of water from the lake.

We can from these facts draw a picture of the appearance of the Dell, when Nathaniel Cantley in 1882 was appointed Superintendent of the Gardens. We see a gentle, and (except after rain) very small stream running from the Tyersal into the head of the Garden Lake over a sandy bed in a hollow that had been embanked on one side, and with cooly lines upon the other.

Cantley, an excellent organiser, removed the lines to a place outside the Gardens limits, and thereupon considered to what use he could put the vacated site. Murton, his predecessor, had failed in an attempt to make a fernery at a place close to the head of Maranta Avenue: and as Cantley, like Murton, was anxious to succeed in such an undertaking, he sought for a new site and selected the dell. To succeed he wanted a more sure supply of water than the stream gave, and this is how he tried to meet the need. Having removed the cooly lines and having carried the water underground to the lake (it is by no means clear why), he constructed a triangular concreted tank, about 140 feet long, and at the base 65 feet broad, where it was six feet deep. Probably by means of the earth from the tank mounds for the ferns were then thrown up between the tank and the head of the lake, mounds not higher than that the water supply could be led on to them. But unfortunately the tank was not a success, for it could not be kept watertight: and what with illnesses and with other work Cantley never created the fern garden that he aimed at. It is to be assumed that the water was to reach the ferns by runnels along the tops of the mounds. For overflow, (as recent observations on the spot have shewn) he laid in the first place a line of gas piping to conduct the water from the tank, and then he constructed a much larger circular brick channel above it. These escapes passed in a straight line direct to the lake, and obviously did not water the mounds: other contrivances must have been thought of for that. But Cantley died with them unfinished. An old guide book indicates the Dell to have been then as in plan No. 1.

Because it was clear that these mounds could not function as their originator had contemplated, they were somewhat altered in shape by Mr. Ridley, and the tank was put to a new service, i.e. for the accumulation of leaf mould. The mounds were clothed with a variety of plants: and at the end of Mr. Ridley's service they were in shape as in plan no. 2 carrying palms and ferns and shade plants of various orders, and a few very interesting trees.

It will be observed that there were two circular paths enclosing the mounds: one of these was at the lowest elevation, and the other above it by six feet. These paths were narrow, and it was impossible in the morning to pass along them with comfort by

reason of the dew-laden foliage arching into them. Moreover the lower paths could not be kept free of mud. It was obvious that changes had to be made as soon as possible: and alterations were commenced in 1914 when by means of dredgings from the lake the lower paths were raised.

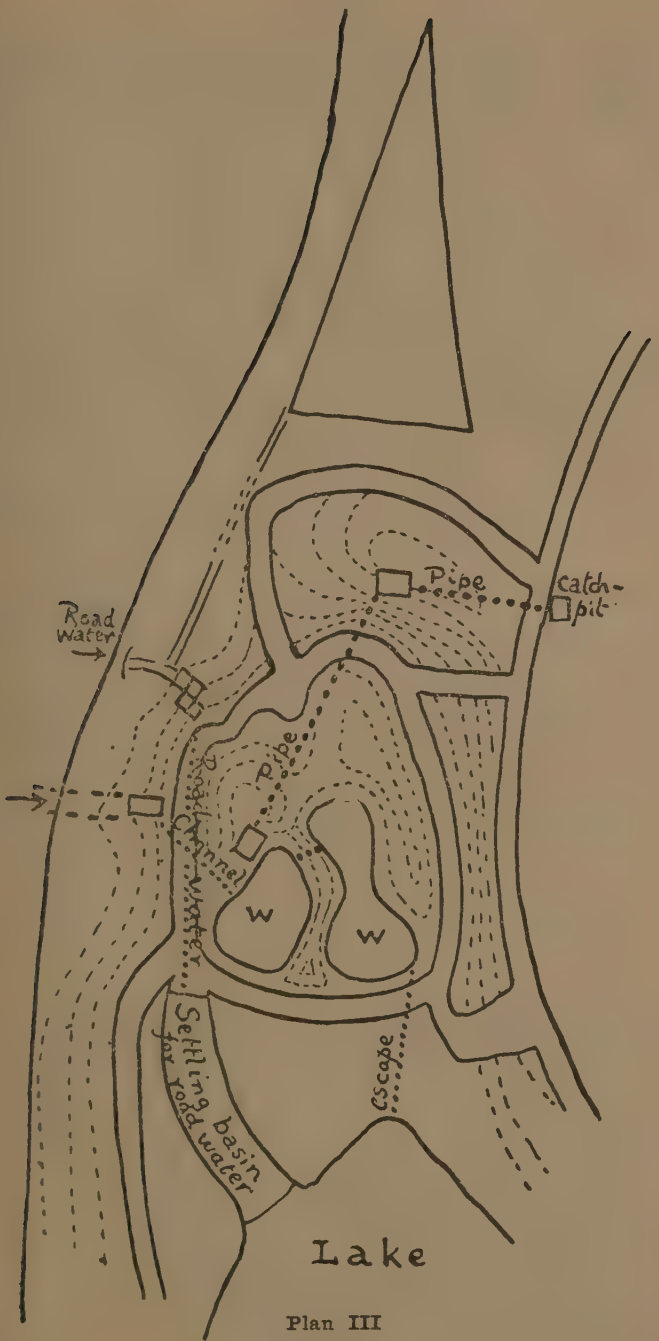
In 1915 the upper circular path was closed, and a new and much wider path with a greater diameter was made within the lower end of the cistern. This involved the erection of a mound along it to hide the leaf-mould pit. The drainage from the leaf mould was provided for at the same time by a channel behind a coral wall towards the public road. The silt off that road had been a source of annoyance in the garden for a long time, though the Municipality had done their best by steps and baffles in the road-side drain to abate it. The better to deal with it four catch pits were constructed in the Gardens where the road enters. The paths above the dell were changed likewise as the plan no. 3 indicates.

In 1916 the appearance of the dell were further improved by the creation of two pools in them, one oval and the other dumb-bell shaped: and those who saw them will remember that they were very pretty. Their surface was about 18 inches above the level of the water in the lake—a necessity to get the best appearance from the adjoining walks—which walks, as said, had been raised to keep them dry. One of these pools is shewn in the accompanying plate.

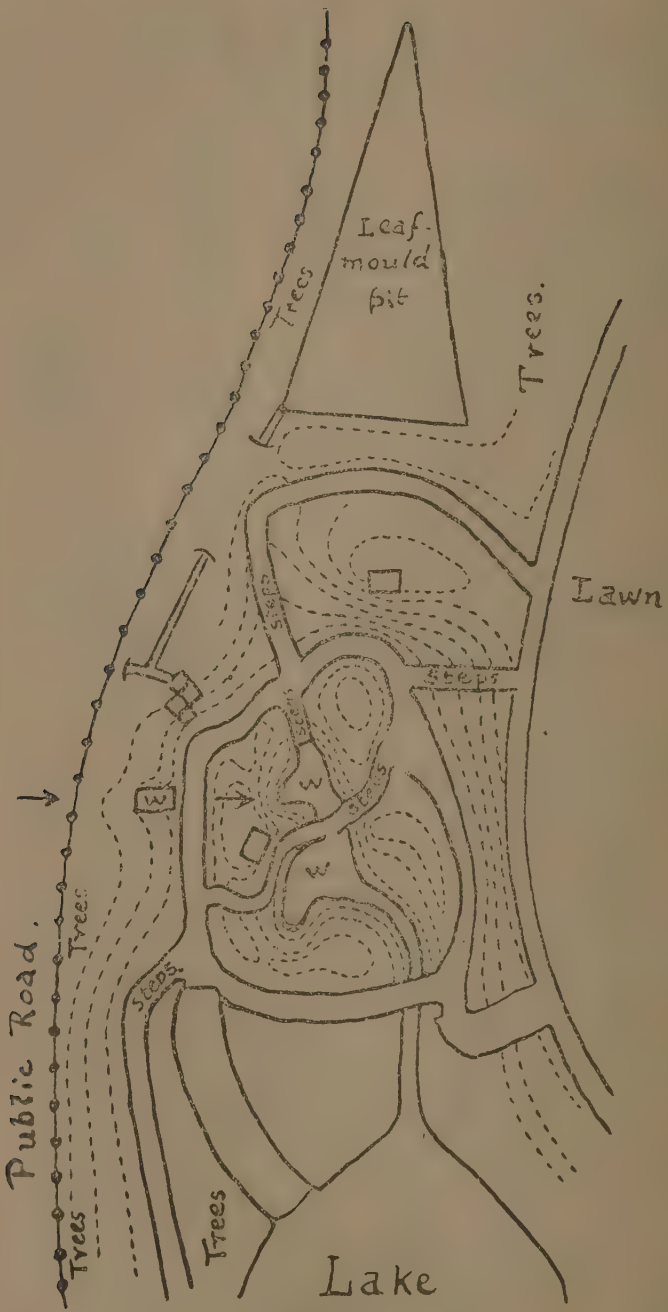
To maintain the water in the ponds two completely hidden bricks tanks were made, the lower supplied from the upper through an underground pipe and the upper receiving rain-water from a certain path-side drains towards the Bandstand Hill. Unfortunately the masonry of the upper tank gave way and undid the contrivance. But at that time it had been discovered in what way Cantley had dealt with the stream from Tyersal, and it was realised that by raising its level so that it filled the culvert and rose another few inches it could be fed into the ponds; accordingly it was so done by means of a simple concrete wall in Cantley's channel, and the bared end of the channel became the pretty rectangular pool at the side of the dell wherefrom the water passed underground into the oval pond, and through the dumb-bell shaped pond, while excess flood water still ran down Cantley's underground channel.

Permanence seemed to have been reached, and the dell had become very pretty.

Unfortunately the Tyersal ponds were found to be a source of mosquitos, and the emptying of them was determined upon. It was then quite unknown how deep the Tyersal lakes were: but a survey revealed that the lowest part of the bed of the lower pond was on a level with the bottom of the Tyersal sluice, and that


Road water
Pipe
catch-pit
Pipe
Drainage channel
Water
W
W
Escape
Settling basin for road water
Lake

Plan III


Leaf-mould pit
Trees
Trees.
Lawn
Steps
Steps
Steps
Steps
Public Road.
Trees
Trees
Trees
Lake

Plan IV

drainage without filling would be impossible unless a free escape of the water into the Gardens was allowed. This free escape was asked for: and it was a great disappointment to feel obliged to concede it, for concession meant the undoing of the water channels in the dell which had been so newly completed.

The concession was made on the ground that the Gardens had no claim to a head of water found to be due to the sluice in the Tyersal grounds being out of order. Thereupon a rearrangement of the dell was commenced, with the intention of keeping its features. In the rearrangement the beds of the two pools were sunk about two feet, united into one, and the Tyersal drainage water was conducted by an "Armco" pipe into the top of the former dumb-bell shaped pond, and out again by another "Armco" pipe into the lake. The sides of both ponds were concreted. By the lowering of the level and because of the wideness of the "Armco" pipe these ponds were thereby made into a part of the lake; and the abundant fish of the lake, which allow no mosquitos to mature, have access to them.

Now a great part of the beauty of the oval and dumb-bell ponds was that they lay open at the visitor's foot, not being sunk at all. The new pond however, being of necessity sunk, threatened to lack beauty in this respect. There was made therefore a path right across the dell bridging the water close against its surface and skirting the edge of what is left of the oval pond, in reality occupying part of the old bed of that pond, having on its north side the wall of one of the irrigating tanks of 1916. This wall is becoming beautiful by reason of a coating of Ficus repens.

The mounds, which now lie as in plan no. 4, are given severally to different forms of vegetation.

I. H. Burkill.

Tulang Daing or Sisik Puyuh
Carallia suffruticosa

Tulang daing means dried fish bones, and sisik puyuh means puyuh-fish skin: both these names belong to a small tree with serrations on the leaves that suggest the bones of a dried fish seen through the skin, which is exclusively used by the Malays of Perak and Pahang as a medicinal herb, but has hitherto remained rather strangely obscure. After much search it has been identified with *Carallia suffruticosa* Ridley (in Journ. Str. Br. Roy. As. Soc. 61, 1912, p. 6): and it is clear that *Carallia spinulosa* Ridley (in the same Journal, no. 82, 1920, p. 184) does not adequately differ.

The type of the first of these two names came from Dusun Tua, upon the east of Kuala Lumpur in Selangor: and that of the second from Tanjong Malim on the Selangor-Perak border. It extends southwards and has been found at Pulau Sebang in Malacca (Burkill 4960). As a medicinal herb, foliage has been got from Grik in northern Perak; and in Pahang from Budu in the Kuala Lipis district, from Beserah in the Kuantan district, and from Bentong. Mr. Ridley records *C. spinulosa* as occurring in Tonkin also.

The chief use that the Malays make of it is as a poultice for the ripening of boils: but it is also given internally under the idea that it is good for expelling worms, and as one of the innumerable herbs administered speculatively to women during the first three days after childbirth. It is again reported as one of several plants which at Grik are used in a decoction for a bath during fever.

The difference between *C. suffruticosa* and *C. spinulosa* is said to be in the inflorescence: but there is none: in both it is cymose. It was in flower and fruit as Tanjong Malim in February 1904, in bud at Dusun Tua in May 1896 and in flower at Pulau Sabang in August 1919.

I. H. Burkill.

Teratological Notes

A.—Abnormalities in Coconut Palms.

I. Polyembryony. On p. 275 of this *Bulletin*, Vol. III, it was stated that the various references which had been consulted by me on the question of polyembryony in coconuts were not sufficiently clear as to make one to be quite positive about the occurrence of the phenomenon in coconuts. Cases, however, have come to my notice which prove beyond all doubt that polyembryony does occur in coconuts.

The ovary of coconuts, it will be remembered, is three-celled, two of which usually become abortive at an early stage of development, only one attaining maturity. The fruit consists of a thin outer skin or *epicarp*, below which is the thick fibrous *mesocarp* surrounding the hard shell or the stony layer of the nut. This shell is formed mainly of the *endocarp*, but the outer integument of the seed is also represented in it as a lignified inner lining of the shell (fide Juliano)[1]. Inside this stony layer is the solid

1. Juliano, J. B.—Origin, Development, and Nature of the Stony Layer of the Coconut (Cocos nucifera L.). *Philippine Journ. Sci.*, XXX (1926), p. 187-200, pl. 3.

Winton, A.L.—Anatomy of the Fruit of Cocos nucifera. *Am. Journ. Sci.*, XII (1901), 265-280. Quoted by J. B. Juliano.

endosperm which is the kernel or "meat" in common parlance and which is lined outside by a thin blackish coating. This coating —we may as well call it "testa"—is derived from the inner integument of the ovule (Juliano[1]). Then comes the cavity partially filled with water or "milk" (watery endosperm) in ripe coconuts. Corresponding to the three carpels of the ovary, there are three markings or "eyes" on the endocarp, two of which have become hard after the degeneration of the two cells of the ovary, while the third "eye" of the developed cell is soft. Just beneath this "eye" is the embryo. When the germination sets in, a suctorial organ—*haustorium* or "foot"—develops into the cavity, at the end of the cotyledon of the embryo, which supplies nutriment to the young growing plant by absorbing it from the endosperm.

Bearing these points in mind, it will be easy to study the nature of the phenomena concerned in the cases described below:—

(*a*).—On July 25th, 1925, there was exhibited at the Taiping Agri-Horticultural Show, a germinating coconut from Kampong Jelutong, Bukit Gantang, North Perak, which had put forth three shoots. The coconut was carefully husked by me to find the three shoots as distinct individuals as far as the soft "eye" through which they had extruded from the endocarp. The two other "eyes" were closed and hard as in an ordinary nut where two carpels are abortive. On breaking the nut open, it was observed that each shoot had its origin in a separate embryo, each having a cotyledon and a haustorium of its own. There was only one cavity in the endosperm into which these three haustoria had developed, and there were neither hard, nor leathery dissepiments in it which are said to be present in a polycellular nut.[2] The kernel inside also showed no signs of any special connection with the closed "eyes" as it showed with the soft "eye." This is then a genuine case of polyembryony in coconuts.

I have also examined many such specimens having two to three embryos from Singapore, Selangor, Penang and Malacca which go to prove that polyembryony does frequently occur in this country. These shoots may emerge out of the husk in all directions, and often in suchwise as to mislead one to think that these extra shoots are due to the functioning of more than one ovule. Hence I look with great suspicion on all the three cases mentioned from Philippines by Quisumbing[3] as ones where more than one ovule were functional.

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2. Furtado, C. X.—Branched Coconut Palms and their Fertility. Gardens' Bull., Singapore, Vol. III (1924), p. 274.

3. Quisumbing, E.—Branching in Coconut. *Philippines Agriculturist*, XV (1926), p. 3-4.

I have not yet come across in this country a genuine case where more than one ovule had developed giving rise to di—, tri—, or polylocular nut, though such cases have been reported from elsewhere.[3] [4] [5]

(*b*).—Costerus and Smith (1923)[5] describe a case of polyembryony in thus:—

"Legit H. A. B. Bunnemeyer, Isle of Nangka near Banka, 1917. One celled nut. From one of the black (germinating) spots there emerged four sprouts each showing its own cotyle. No question of branching. Consequently we have here to do with a true case of polyembryony.

"Mr. Smith is thoroughly convinced that the Coconut with three cohering stems, which we described in 1915, is after all a similar case of polyembryony with this difference only that the embryos of 1915 coalesced whereas in the present case they have maintained their full independence."

The coconut referred to as having been described in 1915 is one which had given rise to three sprouts and which on being carefully opened had not shown any dissepiment whatsoever. "Only one germinating plant forcing its way through one of the black spots was to be seen, but the stem of this young plant showed a separation into three. The advanced state of (dry) specimen did not permit of a further examination into the cause of the phenomenon, but of polyembryony there can be no question." No further details or reasons are given why Dr. Smith thinks this to be a genuine case of polyembryony and not of fasciation or branching.

(*c*).—In the Botanic Garden, Penang, there is a "coconut palm" which has three distinct individual stems from the base. Mr. Mohamed Hanif who has been long connected with the garden, informs me that the three stems have orginated from one coconut fruit and that it was planted there in 1901. Only two stems are bearing fruits, while the third one is yet barren and is also very much shorter than the other two. The small growth of this third stem is in all probability due to the fact that twice during its growth it was very badly attacked by borers (there are still marks on the palm of these attacks). The injury caused by the attacks must have retarded the growth very considerably, giving thereby the other two stems a chance to overshadow this one and to make its further development and production of flowers rather difficult. The overshadowing caused by another palm growing close to it may be an additional cause why this stem is weak and infertile. There is another similar palm with two fertile, and

4. Costerus, J. C. and J. J. Smith.—Studies in Tropical Teratology. *Annales Jard. Bot. Buitenzorg*, XXIX (1915), p. 84-85, and plates.

5. Ibid ibid —ibid XXXII (1923), p. 26 and plates.

one barren, stems in the Botanic Gardens Cooly Lines, Penang, which have originated (*fide* Mr. Haniff) also from one nut. The short and barren stem shows signs of injury in the past. In a private compound at Burma Road, Pulau Tikus, Penang, there is a tree about forty years old which has two stems, distinct from the base, both of which are producing fruits.

II. The Development of the Usually Abortive Ovary in Male Flowers. A coconut spadix was exhibited at the Taiping Show, 1925, which had numerous banana-like fruits and only two nuts of normal shape. The latter were borne in the regions of the spadix where normally female flowers are produced, while the former occupied the positions of male flowers. Apparently this is a case similar to the one quoted on page 263 of this *Bulletin*, III, the banana-like fruits being the result of the development of the usually abortive ovary in male flowers.

III. Albino Coconut Seedlings. In the Taiping Show, 1925, there were exhibited two coconut fruits which had put forth completely albino shoots. The albinism was apparently due to some internal factor, and may be a case of chlorosis due to lack of ferruginous products in the endosperm. It could not be attributed to the lack of light as the plants received ample sunlight at the show (and they must have been exposed during the transit), and because normally coconut seedlings germinated in darkness such as obtained in a closed house, have greenish leaves. Neither nut had put forth any roots out of the husk. From the shape, size and colour, the nuts appeared to have come from the same spadix. Further investigations on these nuts were not possible as they were not for sale.

IV. Suppression of Spikelets in Coconut Spadices. Ordinarily a coconut inflorescence consists of many flower-bearing spikelets produced on a fleshy stalk, which usually does not bear any flowers. At the Agri-Horticultural Shows of Taiping and of Kuala Lumpur, 1925, inflorescences were exhibited which were abnormal in that the axes were unbranched, the flowers being borne directly on them.

The flower-bearing region of one such specimen from Taiping measured three feet and four inches, while the non-flowering portion towards the tip was nearly six inches long, and towards the base over eight inches. The bearing portion of the stalk was occupied by female flowers which were more than a hundred in number. In the basal portion, the flowers were arranged in pairs, each pair being some distance apart from the other, and their arrangement resembled that of the male florets on the spikelets of normal inflorescences. The space between these pairs of flowers gradually decreased towards the end so that in the upper third of the bearing stalk the female flowers were so thickly crowded together that they did not admit any special relation between any two consecutive

flowers. On many of the cushions on which the pairs of female flowers were seated, there were two male florets, one on each side of the pair, while in the upper portion where the flowers were very close to each other one could notice occasionally one male floret between two consecutive female flowers. All the male flowers present at the time of examining the inflorescence had shed their pollen and were quite dry. Many of them dropped down with a slight shake, leaving behind no clear marks or scars to show that they were present there. Like normal flowers, they (male flowers) had six segments in perianth, six stamens and a vestigial ovary.

All the female flowers examined were morphologically normal, except that the papery yellow ring which is usually found around the base of the ovary was occasionally adorned with teeth varying from one to six in number. (For the morphological value of this ring see note on Horned Coconuts). The development of these flowers was acropetal so that the youngest flowers were found at the terminal end. Though many of the flowers towards the basal end had their stigmatic portion out of the perianth envelope, not a single one of them was ripe to receive pollen. This therefore means that any nut developed on such inflorescences would be a result of cross-pollination, unless of course they are fertilised by the pollen from another inflorescence on the same tree or by pollen from the same inflorescence which had retained its vitality till the female flowers had become ready to receive it. That similar inflorescences are not infertile was proved by two other such inflorescences, one at Taiping and the other in Kuala Lumpur. The Taiping specimen had three well-developed nuts and the Kuala Lumpur one had five, in their distal end.

Owing to the advance stages of all such inflorescences examined no further details could be gathered as to the exact relation of the male to female flowers, or as to the nature of the phenomenon concerned in the monstrosity.

I was told in Taiping that the palms which produce these monstrous inflorescences have the habit of producing such monstrosities many times during the course of a year. If so, it would be worth while to keep the palms under observation so as to study how these inflorescences originate, what exactly is the composition and nature of the spathes enveloping them, of young flowers, etc. Such a study may help to throw light as the cause and the nature of the phenomenon involved.

Costerus and Smith[6] who have had a better opportunity of studying such specimens record that all the female flowers in such inflorescences they examined were paired, each female flower being

6. Costerus and Smith.—Ann. Jard. Bot., Buitenzorg, XXXII (1923), p. 24-25 and plates.

flanked by two male florets, but that these male florets soon perished. Similar inflorescences having a side branch have occasionally come to their notice.

V. Horned Coconuts. At the Malacca Agri-Horticultural Show, 1926, three "horned" coconuts (*kelapa tandok*) were shown, each having a horn in appearance similar to the husk. This horn measured five inches in length, and one and one-fourth inches thick in the central portion. It had two small lobes one on each side of the principal one which was large and thick. A copious exudation of gum was found on the inner side of the horn (the side towards the nut), and where there was gummy exudation, the epidermis of the horn seemed to be much affected though the epidermal tissue of the nut appeared to be quite intact. The perianth was then carefully removed from the nut and it was found that this horn was due to the abnormal development of the one side of the papery ring that is usually found between the perianth and the nut, the growth of the other half of the ring having become arrested at an earlier stage, so that it was not visible when the perianth was still attached to the nut. This portion of the ring also had one principal central lobe which measured about one centimeter from the tip of the base, and two small slightly developed ones, and it resembled the perianth in texture. At the tip of the central lobe abundant exudation of gum was noticed. The thalamus had also grown out a little more than usual, especially on the side of the horn, so that the horn could be mistaken for a basal outgrowth of the nut. The horn when cut open was found to be full of fibrous tissue only, like that of the husk, while the nut itself was normal and had all its three "eyes" as usual. The perianth consisted of six normal segments. Hence the view put forward by Masters[7] that these horns are due to the hypertrophy of the perianth segments is untenable.

Petch (1924)[8] describes similar cases of horned coconuts and mentions that the horns may vary in number from six downwards and that they sometimes coalesce in pairs, or two or three may unite by their tips. Some of these horns may be fringed by a thin wing, resembling in texture the segments of the perianth. In all such cases examined by him perianth segments were also present and were normal.

Costerus and Smith[9] figure somewhat similar cases in the Buitenzorg *Annales* which they consider to be instances of

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7. Masters, M. T.—*Vegetable Teratology* (1869), pp. 428-429).

8. Petch, T.—Horned Coconut. *Year-Book Dept. of Agric., Ceylon,* (1924), p. 20-21.

9. Costerus, J. C. and J. J. Smith.—Studies in Tropical Teratology. *Annales Jard. Buitenzorg,* XXXIII (1923), p. 95 and fig. 23.

apocarpy, but in the absence of a detailed description, those cases cannot be compared with the above described ones.

Petch seems to favour the view that the horns are due to a duplication of the segments of the gynaecium. But I am inclined to adopt his less favoured view that the horns represent the six stamens. The following will make clear the position of my view:

Examining flowers of coconut, one usually finds in the male, six perianth segments surrounding six stamens inside and a rudimentary pistil in the centre, and in the female, six perianth segments, a fertile pistil in the centre, and a papery ring between the base of the pistil and the inner perianth segments; that is, the papery ring occupies the place of the androecium in the male flower. May not then this papery ring in the female flowers represent the androecium which in the course of evolution has been reduced to this vestigial state? The fact that this papery ring is invariably present in the female flower, and a vestigial ovary is the male flower, and that the ring is a growth quite distinct from the perianth and the ovary, lends support to this view. And from the examination of the horned nuts exhibited at the Malacca Show, it was quite evident that the horns were due to the development of portions of the ring.

Gadd (1924)[10] describes abnormal female flowers of coconut where three carpels were fused only at the base, being free to a greater or less extent at the apex. "Between the perianth and the gynaecium was a ring of six papillae, in a position which stamens would be expected to occupy, if present." These flowers seem to represent a somewhat earlier stage in the evolution of the female flower of coconut.

Recent histological studies made by Juliano[11] regarding the ontogenetical development of the female coconut flower from an additional evidence in favour of the view that the papery ring is a modified androecium. He shows by means of microtome sections that the development of the floral structures is acropetal, that is, the outer two prophylls are first differentiated from the primordium, then the sepals and the petals follow in succession. The ring which he calls "aril" arises just after the formation of the petals but much before the primordium has differentiated into an ovary and carpels. Hence therefore the ring or the horns cannot be an outcome of the multiplication of the carpels.

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10. Gadd, C. H.—An Abnormal Inflorescence from a Nut. *Year-Book, Dept. of Agric., Ceylon,* (1924), p. 21-23.

11. Juliano, J. B.—Origin, Development, and Nature of the Stony Layer of the Coconut. *Philipp. Journ. Sci.,* XXX (1926), p. 187-200 and pl. 1-3.

B.—Ananas sativa.

It is not uncommon to see various forms of monstrosities in the fruits (soroses) of pine-apples (*Ananas sativa*). Hitherto I have been the following abnormal forms in this Peninsula:—

I. Fasciation. One of such monstrous pine-apple fruits had cylindrical base about two inches long and was much stouter than the average fruits of the same variety. The fruit then showed a tendency to taper in one axis and expand in the other. The expansion had occurred to such an enormous extent that it had given rise to several twistings and bendings. Measurements with a tape would indicate that the topmost part of the fruit had become more than two feet in breadth, while its thickness had been reduced to about an inch or a little more. The foliose shoot that usually crowns a pine-apple fruit had also fasciated apace with the fruit. Its vertical axis had become abbreviated to a very considerable extent and the leaves were reduced to mere scales, about an inch and half in length and half an inch in breadth, so that the expanded apex of the fruit appeared as if fringed with these scaly leaves. This forms appears to be very rare in pine-apples.

Another form of fasciation that is more commonly met with in pine-apples is one which differs from the former in that the fruit in the latter flattens to a less extent and produces many cylindrical heads, each with a normal or reduced crown of its own. I have seen pine-apples with three, five and seven heads.

The third kind of fasciation affects the crown of the fruits only. In one such specimen the leafy crown had trifurcated, the fruit itself remaining normal. That these three shoots were due to fasciation of the main axis and not to the proliferation of the two axillary shoots was easy to be seen as the leaves were reduced to small scales and the lower portion of the stalk had become very much thicker.

Fasciation showing various grades of these three cases have been also observed.

II. Proliferation. On the stalk bearing the three-headed fasciated fruit described above, there were many, much proliferated, vegetative shoots arising from the axils of the bracts. They had grown as long as the fruit itself, and were present only in the upper portion of the stalk, close to the base of the fruit, lower portion of the stalk bearing no such shoots.

In another specimen there was a similar proliferation of shoots in the axils of bracts close to the fruit, but these shoots were reproductive so that they produced many banana-like, elongated fruits at the base of the main fruit.

Sometimes axillary shoots on the base of the leafy crown of the pine-apple fruit grow very vigorously, even much faster than the main shoot itself.

Proliferation of vegetative shoots on the stalk or on the crown of the fruit is very common, almost a "normal" phenomenon in pine-apples. Production of fruits at the base of the principal fruit has been noticed by me only twice in this country.

C. X. Furtado.

Dioscorea tamarisciflora, *Pr. and Burk.*

In September, 1890, Mr. Charles Curtis collected in the Langkawi islands a Dioscorea with male flowers, which was described in 1914 under the above name in the Journal of the Asiatic Society of Bengal, N. S., 10, p. 22, and until recently it has remained known only by his specimens. But in the early part of 1924, two collectors, Mohamed Nur and Kiah, were sent from the Botanic Gardens, Singapore, to the mountain of Gunong Pulai in the south-western part of the State of Johore, whence they brought back living tubers of the same plant: and these gave upon cultivation in the Gardens, both male and female plants. It is possible therefore to add to what is already known about it.

The tubers are black, densely covered with short roots, sparingly branched, the branches more or less cylindrical. They form at the surface of the soil and descend for 20 to 30 cm. It would seem by their appearance and surface growth as if they may be altogether unappetising to the hungriest of wild pigs, the chief destroyers of edible forest tubers. The plate given here well illustrates them.

The stems towards the base and also above carry sparingly small prickles. They attain the thickness of a crow-quill, and climb over any convenient support to 2 or 3 metres.

The upper leaves have been described. The lower are similarly ternate and scarcely differ. All leaflets are relatively small, the middle attaining little more than 5 cm. by 1.75 cm.

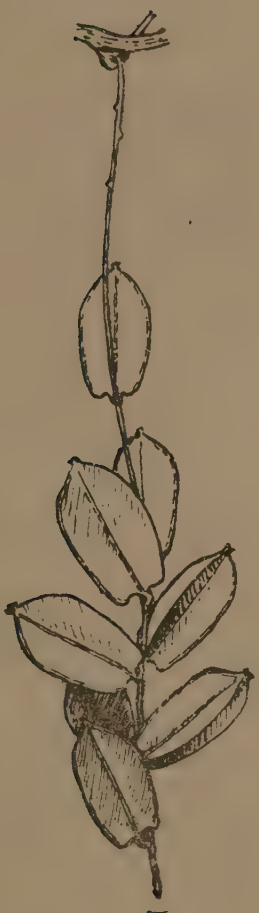
The male flowers have also been described. They were produced in Singapore in the greatest abundance.

The female flowers were more sparingly developed. They offered nothing that is not seen in the closely allied species of Dioscorea, section *Lasiophyton*.

The capsules resemble those of *D. pentaphylla*: but are slightly more acute, as the accompanying line block shews.

From the Langkawi islands to Gunong Pulai in a straight line it is about 450 miles, i.e. almost the whole length of British Malaya; and the species may occur sporadically throughout the Peninsula. It has been already found in one other place, namely

Dioscorea tamarisciflora, *Pr. and Burk.*



A fruiting spike of *Dioscorea tamarisciflora*, together with outlines of five capsules:—no. 1 an unusually rounded capsule of *D. tamarisciflora*, and no. 2, a normal capsule: nos. 3, 4 and 5, capsules of *D. pentaphylla* from various places in India, thus, no. 3 from the Khasya Hills (Hooker and Thomson), no. 4 from Hoshangabad in the Central Provinces (Duthie, 10578) and no. 5 from Behar (Hooker). All nat. size.

on rocks near a village named Pulai (from the Alstonia tree, like the mountain) in southern Kelantan close to the Pahang boundary (Mohamed Nur. 11944). It has not been met with outside the Peninsula.

D. Prain.
I. H. Burkill.

A List of Mosses Collected in the Botanic Gardens, Singapore.

In the previous issue of the Gardens' Bulletin appears a list of all mosses hitherto collected in the Malay Peninsula, prepared by Mr. H. N. Dixon, who has himself determined the majority of the specimens concerned. Our best thanks are due to Mr. Dixon for the very great amount of work which he has put into the preparation of this paper. Before receiving Mr. Dixon's list, I had compiled a list of mosses found in the Singapore Gardens, with such first-hand observations as I had been able to make concerning their habits of growth, as it seemed that few observations of the kind had been recorded. This list is here printed as a supplement to Mr. Dixon's paper. It contains no references to collectors or numbers (these can be found in the complete list) but only names of species and such information as to habit and habitat as I have found on herbarium labels or collected myself. Not having made a critical study of mosses, in many cases I can only speak of the habitats of individual specimens collected by me and identified by Mr. Dixon, but there are a few common species which it is easy to recognise at sight, and of these it is possible to speak with greater certainty.

The Gardens present a fairly wide range of habitat for mosses, from the most exposed positions on the ground or on trees to the shade of the rockeries and the Gardens Jungle; but there is no place so moist and shady as much of the natural jungle of the Peninsula. The conditions are on the whole artificial, and this is reflected in the character of the moss flora; the more typical forest species are infrequent or absent.

A striking feature of the list, referred to by Mr. Dixon in the introduction to his paper, is the large proportion of species of *Syrrhopodon* and *Calymperes;* this is more marked in Singapore than in the north of the Peninsula. In Singapore Island 32 species of the two genera have been found, out of 51 for the whole Peninsula; from the north fewer are recorded, 16 only having been found in Penang (mostly in the Waterfall Gardens or on the hill) which after Singapore is probably the most-collected area. In recent collections I have paid particular attention to these genera, and in searching Penang Gardens it was with difficulty that they could

be found, whereas in Singapore they occur on tree trunks in any slightly shaded spot. It is possible that the more seasonal climate of Penang and the north of the Peninsula is not so favourable for these mosses; in Penang a pronounced dry season early in the year is the rule. They are not usually found in dense shade, but in light shade, on tree trunks, and sometimes on rocks or on the ground (according to the species and the conditions). They do not usually grow in full sunlight, except some of the more resistant species, (e.g. *S. borneense;* this grows in a close cushion which can retain moisture). During rather dry weather they are often much shrivelled up. It is perhaps their habit of growing in somewhat exposed places, together with inability to withstand severe drought, which causes their restriction, on the whole, to places with a fairly heavy and evenly distributed rainfall, or a continuously high atmospheric humidity.

Microdus miquelianus (Mont.) Besch.

On ground in the open.

Campylopus serratus Lac.

Very abundant. It grows on the ground, frequently on the lawns where the grass is poor, in the open, or more usually in moderate shade; sometimes in a close pure growth. It is usually sterile; I have found male plants with antheridia, but not ripe fruits.

Leucobryum sanctum (Brid.) Hpe.

Very abundant locally. It grows on the ground, requiring more shade than *Campylopus serratus*, and often forms large pure patches under trees, or mixed with *Campylopus* and such grasses as will tolerate a little shade. It may also grow on the bases of trees to some extent. No fructifications seen.

Leucophanes octoblepharoides Brid.

L. albescens C. M.

Leucophanes spp. usually grow on tree or palm trunks in masses, rather in the same positions as *Syrrhopodon* spp. They may also grow on the ground in modarate shade.

Fissidens mittenii Par.

Found on bare ground under the shade of a *Phoenix sylvestris*.

F. crassinervis Lac.

Mr. Ridley has collected this species in the gardens. I have found it in the Reservoir jungle on the ground by pathsides in shady places rather abundantly, though not forming dense masses like the next species.

F. zippelianus D. & M.

Very abundant on brick drains and on rocks in shady places, also on hard ground (stiff clay) in the shade. It forms a dense continuous mat, and has not yet been observed bearing sporogonia. It avoids the mortar between the bricks of the drain (this is sometimes covered with a hypnoid moss) and, appears to avoid the coral in the rockeries.

Syrrhopodon ciliatus Schw.

Found on trunks of sago palms in shady places, froming a close mat, sometimes freely fruiting.

S. fasciculatus Hk. & Grev.

On the ground beneath an old *Artocarpus rigida*, and on the base of its trunk, shaded also by fronds of *Davallia* growing about the tree.

S. involutus Schw.

S. flavus C. M.

On a dead tree trunk in the Gardens Jungle, abundant.

S. manni C. M., f. **minor** Fl.

On tree trunks in Gardens Jungle, creeping. Apparently a common species in Singapore, but always the f. *minor*.

S. repens Harv. Apparently a common species in Singapore.

S. revolutus D. & M.

On a Sabal trunk, underneath epiphytic ferns (*Asplenium nidus*) in thick rounded cushions. The fern roots with their accumulated debris are like huge sponges, and water flows down from them for some time after rain has ceased. The tufts of *Syrrhopodon* are also sponge-like and can hold much water. Apparently the same species occurs on the trunk of a big *Dyera costulata*, where also it is shaded and has ferns above it.

S. rufescens Hk.

Collected several times in Singapore by Mr. Ridley. Probably grows on tree trunks, but the only definite habitat note is its occurrence on the mass of roots of an old *Platycerium*. This is similar to the habitat described for the last species.

Calymperes dozyanum Mitt.

On a raised root of *Albizzia* sp., in a rather shady spot.

C. hampei D. & M.

On roots and ground in shade.

C. nicobarense Hpe.

Collected by Mr. Ridley in the Economic Garden. Apparently a common species in Singapore; otherwise only known from Langkawi and the Nicobar Islands.

C. salakense Besch.

Collected in the Gardens once, by Mr. Ridley.

C. serratum A. Br.

Obtained by Mr. Ridley either in the Gardens or on Bukit Timah; exact locality uncertain.

Barbula indica Brid.

Grows in thick cushions, in rather exposed places. It is the commonest moss on open brick drains, and does not avoid the mortar. It will grow also in moderate shade, in which case it may be found side by side with *Fissidens zippelianus*.

Macromitrium goniorrhynchum D. & M.

Bryum coronatum Schwaegr.

On rocks in rather exposed places (sun rockery) and on the ground; found also on rocks in moderate shade. It grows both on coral and other rocks. In dry weather it is quite shrivelled up, but during wet periods soon forms thick green cushions, which later bear abundant fruits.

Myurium rufescens (Hornsch. and Rw.) Fleisch.

Callicostella prabaktiana (C. M.) Jaeg.

Pelekium velatum Mitt.

On coral in shady rockeries, abundant. This is the only record from Singapore; in other parts of the Peninsula it is usually found on limestone.

Ectropothecium buitenzorgii (Bel.) Jaeg.

E. monumentorum (Dub.) Jaeg.

E. moritzii (C. M.) Jaeg.

Very abundant (though possibly mixed with other species). It often forms a close carpet on the ground in shady places, and on the bases of tree trunks; also to some extent among grass.

E. singaporense Dixon.

Collected once only, "on grass in open" (Binstead).

E. zollingeri (Bry. jav.) Jaeg.

In tank in plant house, fruiting only when left dry (Barkill).

Trismegistia lancifolia (Harv.) Broth.

Isopterygium albescens (Schw.) Jaeg.

On the ground in a shady place. Found also by Binstead on a palm.

I. minutirameum (C. M.) Jaeg.

Plagiothecium miquelii (Bry. jav.) Broth.

This is a very common moss in the Peninsula, usually on old logs in shady places, but also occurring on the ground.

Taxithelium isocladum (Bry. jav.) Ren. & Card.

T. instratum (Brid.) Broth.

T. nepalense (Harv.) Jaeg.

Vesicularia dubyana (C. M.) Broth.

V. montagnei (Bel.) Broth.

V. reticulata (C. M.) Broth.

Meiothecium microcarpum (Harv.) Mitt.

Occurs on palm trunks and elsewhere in more exposed positions than most hypnoid mosses, often with algae of the genus *Trentepohlia*.

Rhaphidostegium caespitosum (Sw.) Jaeg.

Trichostelium Boschii (D. & M.) Jaeg.

T. brachypelma (C. M.) Broth.

T. singapurense Fleisch.

The hypnoid mosses are so alike in habit and are so abundant that I cannot distinguish any of them in the field with certainty, and cannot make any definite statement about the habitat of most of them. They are usually found on tree trunks, on logs or on the ground, in rather shady places.

Hypnodendron arborescens (Mitt.) Lindb.

Small specimens, collected in the Gardens Jungle by Mr. Ridley.

R. E. Holttum.

Additions to the List of Fraser Hill Plants.

This list is intended to supplement the enumeration of Fraser Hill plants published by Burkill and Holttum in this Bulletin, Vol. III, pp. 33—110.

The material from which it is compiled was obtained by a native collector working under the writer's supervision in August 1923, and by Mr. R. E. Holttum in the following month.

A few plants from the collections of Messrs. Burkill and Holttum have been added, where these have been determined since the publication of the original list.

All the plants, except where otherwise noted, were collected between the 3800 and 4200 feet contours.

SCHIZANDRACEAE.

Kadsura cauliflora, *Bl.* A big liane of Sumatra and Java; in the Peninsula Penang, Perak, Singapore, usually at low altitudes. (11197).

Kadsura lanceolata, *King.* A woody climber, endemic, Taiping Hills at low altitudes. (11266 at 4800 ft.).

ANONACEAE.

Artabotrys venustus, *King.* A big liane of Siam; in the Peninsula Taiping Hills and Gopeng, Perak. (11316).

Polyalthia sp. No flowers collected. (11341).

Goniothalamus Curtisii, *King.* A shrub or small tree, endemic, Perak and Selangor. (11191).

Goniothalamus subevenius, *King.* A small tree, endemic, Kedah Peak, Kelantan, Perak. (Burkill and Holtum 8896).

POLYGALACEAE.

Polygala monticola, *Ridl.* A small shrubiet, endemic, montane, Gunong Bubu, G. Tahan, G. Mengkuang Lebah, G. Benom. (11272 at 4800 ft.).

HYPERICACEAE.

Cratoxylon arborescens, *Bl.* A tall tree of Indo-Malaya and Indo-China; in the Peninsula Perak, Penang, Selangor, Singapore, usually in the lowlands.

FLACOURTIACEAE.

Hydnocarpus castanea, *Hook. fil.* A tree of Burma and Tenasserim; in the Peninsula not uncommon from Langkawi to Malacca. (11277 at 4800 ft.).

GUTTIFERAE.

Garcinia eugeniaefolia, *Wall.* A tree of Tenasserim; in the Peninsula Kedah to Singapore, a lowland species. (11321).

Garcinia ?Hombroniana, *Pierre.* A small tree of Tenasserim; wild or planted over the whole Peninsula. (11224).

Calophyllum canum, *Hook. fil.* A tree, endemic, Penang to Singapore. (11282).

Calophyllum near **Griffithii,** *T. Anders.* A tall tree. (11463).

Calophyllum ?retusum, *Wall.* A tree, endemic and rare, known only from Johore and Singapore. (11468, sterile specimens only).

TERNSTROEMIACEAE.

Anneslea crassipes, *Hook. fil.* A shrub or small tree of Indo-China and the Philippines; in the Peninsula montane, Kedah, Gunong Tahan, the Main Range and Mt. Ophir. (11455).

Adinandra integerrima, *T. Anders.* A small tree of Siam and Indo-China; common in the north of the Peninsula. (11149 at 3700 ft.).

Adinandra macrantha, *Teys. & Binn.* A tree of Sumatra and Java; in the Peninsula Perak, Pahang, Selangor and Johore. (11320, Burkill and Holttum 7760).

Gordonia singaporeana, *Wall.* A tall tree, endemic and common, more especially in the North. (11177, 11454).

Pentaphylax arborea, *Ridl.* A tree 30 or 40 ft. tall, endemic and local. (11332).

Pentaphylax malayana, *Ridl.* A bush, endemic, Gunong Tahan, G. Benom and the Main Range, not common, but abundant where it occurs. (11225).

Ternstroemia micrantha, *Choisy.* A bush of Sumatra, Java, and Borneo; in the Peninsula known only from this locality. (fide Ridley, Flor. Mal. Pen., Supp. p. 291).

STERCULIACEAE.

Sterculia hyposticta, *Miq.* A small shrub of Indo-China, Tenasserim and Sumatra; in the Peninsula not uncommon in the North. (11382 at 3900 ft.).

TILIACEAE.

Elaeocarpus Hullettii, *King.* A tree, endemic, Penang to Singapore, but not very common. (11306).

RUTACEAE.

Evodia macrocarpa, *King.* A tree endemic and rare, Penang and Taiping. (11018).

Evodia pilulifera, *King.* A shrub, endemic and montane, Taiping Hills, Pahang, Mt. Ophir. (11175).

Tetractomia Roxburghii, *Hook. fil.* A tree, endemic, Penang, Taiping, Singapore. (11328).

Zanthoxylum myriacanthum, *Wall.* A thorny shrub or tree, endemic, Penang to Malacca. (11310).

Glycosmis tomentella, *Ridl.* A shrub, endemic and rare, Menuang Gasing, Selangor. (11170).

SIMARUBACEAE.

Eurycoma apiculata, *Benn., var.* A shrub, endemic, Penang to N. Johore, commonest in the north. (11230, and collected here by Ridley).

MELIACEAE.

Chisocheton macrophyllus, *King.* A tree of Java; in the Peninsula Penang, Selangor, Singapore. (11390 at 3500 ft.)

Dysoxylon costulatum, *Miq.* A tree of Sumatra; in the Peninsula common. (11284).

Dysoxylon ?macrothyrsum, *Miq.* A tree of Java and Borneo; in the Peninsula Taiping to Singapore. (11451).

Aphanamixis Rohituka, *Pierre.* A tree of India to Sumatra and China; in the Peninsula common. (11322).

OLACACEAE.

Gomphandra lanceolata, *King.* A shrub, endemic and common. (11278).

Gomphandra penangiana, *Wall.* A shrub, endemic, not very common, Penang to Malacca. (11260).

ILACACEAE.

Ilex Kelsallii, *Ridl.* A small tree, endemic and rare, known only from Bukit Hitam, Selangor. (Burkill and Holttum 8693).

Ilex Maingayi, *Hook. fil.* A tree, endemic, not common, Penang, Perak, Selangor, Singapore. (11325).

Ilex triflora, *Bl.* A bush of Indo-Malaya and China; in the Peninsula common in the mountains. (11294).

CELASTRACEAE.

Perrottetia alpestris, *Loesn.* A bush of Sumatra, Java, Borneo and the Philippines; in the Peninsula not common, Perak. (11125 at 3700 ft., and as *Maesa perakensis,* Ridl. in the original enumeration, Gardens' Bulletin Vol. III p. 58).

SABIACEAE.

Meliosma nitida, *Bl.* A shrub of small tree of Sumatra and Java; in the Peninsula common, usually in the lowlands. (11185, 11209).

ANACARDIACEAE.

Melanorrhoea Curtisii, *Oliv.* A tree endemic, Kedah Peak, Penang Hill, Taiping Hills. (11229, 11336).

? Melanorrhoea inappendiculata, *King.* A tree. (11409, at 4200 ft., sterile specimens only).

LEGUMINOSAE.

Ormosia gracilis, *Prain.* A slender tree, endemic and rare, Taiping Hills. (11326).

Saraca taipingensis, *Cantley.* A small tree, endemic, common from Taiping to Malacca. (11387 at 3200 ft.).

Pithecolobium Kunstleri, *Prain.* A small tree, of Borneo; in the Peninsula Perak to Johore, usually in lowland forest. (11025).

ROSACEAE.

Parinarium rubiginosum, *Ridl.* A small tree, montane, endemic and rare, Gunong Tahan. (11147 at 3700 ft., 11301).

Pygeum Hookerianum, *King, var.* A shrub or small tree, endemic, the species not uncommon, the var. from Kiang Gates, Selangor (fide Ridley). (11164).

Pyrus granulosa, *Bertol.* A tall tree of India to Sumatra; in the Peninsula purely montane, Taiping Hills, Gunong Tahan, Cameron's Highlands. (11241).

LEGNOTIDACEAE.

Gynotroches axillaris, *Bl.* A small tree of W. Malaysia to the Philippines; in the Peninsula common. (11016).

MYRTACEAE.

Eugenia alycifolia, *Ridl.* A tree, endemic and local. (11213).

Eugenia goniocalyx, *Ridl.* A small tree, endemic and local. (fide Ridley, Flor. Mal. Pen. Supp. p. 309).

Eugenia Holttumi, *Ridl.* A tree, endemic and local. (Burkill and Holttum 7751).

Eugenia linoceroidea, *King.* A tree, endemic and rare, Perak. (11456).

Eugenia punctulata, *King.* A tree of Borneo; in the Peninsula not uncommon in the South and on the East coast. (11261, 11469).

Eugenia subdecussata, *Duthie,* var. montana, *King.* A small tree, endemic, the species common, the var. from Kedah Peak and Gunong Batu Puteh. (11211, and collected here by Ridley).

MELASTOMATACEAE.

Sonerila caesia, *Stapf.* A herb, endemic, not common, Upper Perak, Batang Padang, Gunong Batu Puteh. (11033).

Phyllagathis rotundifolia, *Bl.* A creeping herb of Sumatra; in the Peninsula common. (11182).

Medinilla Scortechinii, *King.* An epiphytic shrub, endemic and montane, Taiping Hills and the Main Range. (11135 at 3700 ft.).

Memecylon amplexicaule, *Roxb.* A small tree, endemic, Penang to Singapore. (11212).

SAMYDACEAE.

Casearia minutiflora, *Ridl.* A shrub, endemic and local. (Burkill and Holttum 8581).

BEGONIACEAE.

Begonia longicaulis, *Ridl.* A herb, endemic and rare, Gunong Tahan and G. Kerbau. (Burkill and Holttum 8428).

Begonia isoptera, *Dryand.* A creeping herb of Sumatra and Java: in the Peninsula common, usually in the lowlands. (11103 at 3700 ft.).

Begonia perakensis, *King.* A herb, endemic on the Main Range, but usually below 3000 ft. (11035).

UMBELLIFERAE.

Hydrocotyle javanica, *Thunb.* A creeping herb of Indo-Australia, China and Japan: in the Peninsula not common, usually montane, Taiping Hills, Cameron's Highlands, Upper Perak. (11413 at 3800 ft.).

ARALIACEAE.

Aralia Thomsoni, *Seem.* A prickly shrub or small tree of India: in the Peninsula Penang to Negri Sembilan, usually in hilly localities. (11121 at 3700 ft.).

Schefflera subulata, *Viguier.* An epiphytic shrub of W. Malaysia; in the Peninsula common. (11166, 11244).

Trevesia cheirantha, *Ridl.* A small prickly tree of Burma and Sumatra; in the Peninsula common. (11124 at 3700 ft.).

Trevesia rufosetosa, *Ridl.* A small tree, endemic and local. (11070, and collected here by Ridley).

Brassaiopis speciosa, *Decne. and Planch.* A small thorny tree of Assam, Siam, Sumatra and Java: in the Peninsula known only from this locality. (Burkill and Holttum 7882).

CORNACEAE.

Mastixia *sp.* A tree. "Not recognised, flowers wanted." (Ridley). (11291).

Aralidium pinnatifidum, *Miq.* A small tree of Sumatra and Borneo; in the Peninsula common, usually lowland. (11217).

Nyssa sessiliflora, *Hook. fil.* A small tree of India, Burma, Sumatra and Java; in the Peninsula montane, very rare, only known from Gunong Batu Puteh. (11169).

CAPRIFOLIACEAE.

Viburnum lutescens, *Bl.* A shrub or small tree of Sumatra and Java; in the Peninsula a local species, Ulu Batang Padang and into Pahang. (11202).

RUBIACEAE.

Argostemma ?Hookeri, *King.* A slender creeper, endemic and usually montane, Penang, Gunong Tahan, Selangor, Johore. (11167).

Urophyllum macrophyllum, *Korth.* A shrub or tree of Tenasserim, Java and Borneo; in the Peninsula not uncommon in the north, occurring also in Singapore. (11222).

Brachytome Scortechinii, *King and Gamble.* A shrub, endemic, Kedah Peak, Taiping Hills, and the Main Range. (11178).

Tarenna lancifolia, *Ridl.* A shrub, endemic and rare, Kedah Peak. (Burkill and Holttum 8686, sub *Stylocoryna fragrans,* Bl., Gardens' Bulletin Vol. III, p. 51).

Gardeniopsis longifolia, *Miq.* A shrub of Sumatra; in the Peninsula common. (11172).

Timonius oreophilus, *Ridl.* A shrub, endemic and montane, Kedah Peak, Pahang, Selangor, Mt. Ophir. (11136 at 5700 ft., Burkill and Holttum 8922).

Canthium didymum, *Gaertn. fil.* A bush or tree of Borneo; in the Peninsula common. (11055, 11280).

Psychotria stipulacea, *Wall.* A shrub of Sumatra, common in the Peninsula. (11081 at 3700 ft.).

Cephaelis elongata, *Ridl.* A shrubby herb, endemic and local. (Burkill and Holttum 8627, Ridley 12073).

Cephaelis triceps, *Ridl.* A woody herb, endemic and rare, Kuala Lumpur. (Burkill and Holttum 8435, Ridley 15667).

VACCINIACEAE.

Agapetes pubescens, *Ridl.* An epiphytic shrub, endemic and local. (Burkill and Holttum 7828, sub *Agapetes Griffithii,* C.B.C., l.c. p. 56).

MYRSINACEAE.

Embelia myrtillus, *King.* An erect or climbing shrub of Burma; in the Peninsula montane, Kedah, Upper Perak, Main Range, Mt. Ophir. (11271 at 4800 ft.).

SAPOTACEAE.

Sideroxylon firmum, *Pierre.* A small tree of Bangka and the Philippines; in the Peninsula rare, Penang Hill and Mt. Ophir. (11148 at 3700 ft.).

Sideroxylon sp. A tree. (11461).

Payena sp., near lucida, *DC.* A tree in fruit. (11327).

STYRACACEAE.

Symplocos adenophylla, *Wall.* A shrub or small tree of Sumatra, Bangka, Borneo and the Philippines; in the Peninsula common. (11159, 11458).

Symplocos ferruginea, *Roxb.* A tree of Indo-Malaya to the Philippines and S. China; in the Peninsula Penang, Perak, Pahang, Negri Sembilan, Malacca. (11215, 11462).

Cordyloblaste confusa, *Ridl.* var. with small leaves. A shrub of Borneo and S. China; in the Peninsula rare, Mt. Ophir. (11281).

APOCYNACEAE.

Rauwolfia perakensis, *King and Gamble.* A shrub of Lower Siam; common in the North of the Peninsula. (11107 at 3700 ft.).

Alstonia sp., near **macrophylla,** *Wall.* A tree of which no flowers or fruit have been collected. (11407).

Ecdysanthera rosea, *Bl.* A climber of Java, new to the Peninsula. (Burkill and Holttum 8407).

Trachelospermum obtusifolium, *Ridl.* A climber, endemic and local. (Burkill and Holttum 8898).

ASCLEPIADACEAE.

Tylophora grandiflora, *Ridl.* A twiner, endemic and local. (11482 at 3800 ft.).

LOGANIACEAE.

Fagraea lanceolata, *King and Gamble, not of Blume.* An epiphytic climber, endemic. A doubtful species, of which flowers have not yet been obtained. Collected in the Taiping Hills by Wray. (11288).

Strychnos ovalifolia, *Wall.* A big liane of Borneo; common in the Peninsula. (11188).

Gaertnera latifolia, *Ridl.* A shrub, endemic and local. (Burkill and Holttum 8606).

CONVOLVULACEAE.

Erycibe leucoxyloides, *Prain.* A bushy climber, endemic, Kuala Lumpur, Johore, Singapore. (11324).

Erycibe Stapfiana, *Prain.* A woody climber of Tenasserim; not common in the Peninsula, Larut and Batang Padang, Perak. (11293).

SOLANACEAE.

Solanum Blumei, *Nees.* A shrub of Sumatra, Java and Borneo; in the Peninsula montane in the Taiping Hills, the Main Range, and Johore. (11245).

GESNERACEAE.

Aeschynanthus lanceolatus, *Ridl.* A creeping epiphyte, endemic and rare, known only from this locality and from Cameron's Highlands. (11138 at 3700 ft.).

Ochradocarpa lilacina, *Ridl.* A herb, endemic, not common, montane in the Main Range on Gunong Batu Puteh and G. Mengkuang Lebah. (11046).

ACANTHACEAE.

Strobilanthes Maingayi, *Clarke.* A small undershrub, endemic and montane, Penang, Taiping Hills and the Main Range. (11412 at 3800 ft.).

Pseuderanthemum Teysmanni, *Ridl.* A sarmentose shrub, endemic and common. (11180).

Justicia Maingayi, *Clarke.* A shrubby herb, endemic and rare, Penang Hill. (Burkill and Holttum 8441, placed doubtfully under *J. subalternans* in the original enumeration).

Justicia uber, *Clarke.* A fleshy herb, endemic and common. (11087 at 3700 ft.).

Justicia vasculosa, *Wall.* A herb of Assam, Tenasserim, and Sumatra; widely distributed over the whole Peninsula. (11014).

VERBENACEAE.

Callicarpa sp. A small tree. (11102 at 3700 ft.).

Clerodendron disparifolium, *Bl.* A shrub of Sumatra, Java and Borneo; common in the Peninsula. (11303).

Gomphostemma Curtisii, *Prain.* A large woody herb, endemic, not common, Taiping Hills and the Main Range. (11100).

Gomphostemma lactea, *Ridl.* A woody herb, endemic and local. (11075 at 4200 ft.).

AMARANTACEAE.

Acryanthes aspera, *Linn.* A tall herb, pantropic; common in the Peninsula. (11200).

PIPERACEAE.

Piper Ridleyi, *C. DC.* An erect shrubby plant, endemic, Upper Perak, Main Range, Singapore. (11122 at 3700 ft.).

Piper uncinulatum, *Ridl.* An erect pepper, endemic and local. (11343).

MYRISTICACEAE.

Knema conferta, *Warb.*, var. Scortechinii, *Warb.* A small tree of Tenasserim and Borneo (the species); in the Peninsula the species common, the var. in Perak. (11313).

Knema oblongifolia, *Warb.*, var. monticola, *King.* A shrub or small tree, endemic, the species from Penang to Singapore, the var. montane in Perak. (11126 at 3700 ft., 11249).

LAURACEAE.

Cryptocarya ferrea, *Bl.* A tree of Java; in the Peninsula Penang and Kelantan to Singapore. (11452).

Cryptocarya Scortechinii, *Gamble.* A tree, endemic, not common, Perak and Malacca. (11330).

Nothaphoebe reticulata, *Gamble.* A tree, endemic and montane, Taiping Hills and the Main Range. (11253).

Phoebe declinata, *Nees.* var. sericea, *Gamble.* A tree of Java and Sumatra (the species); in the Peninsula not common. Penang to Singapore, the var. montane in Perak. (11331).

Actinodaphne Maingayi, *Hook. fil.* A tall tree, endemic, Perak, Malacca, Singapore. (11314).

Actinodaphne ?oleifolia, *Gamble.* A shrub of Borneo; in the Peninsula montane, Perak, Pahang. (11232).

Actinodaphne sp. near **Ridleyi,** *Gamble.* A small tree. (11023).

Actinodaphne sesquipedalis, *Hook. fil.* A tree of Borneo (a var. only); in the Peninsula Penang, Perak, Pahang. (11073 at 4800 ft.).

Litsea panamonja, *Hook. fil.* A tree of India, Burma and Lower Siam; in the Peninsula rare, Taiping Hills, Malacca. (11406 at 4200 ft.).

Lindera caudifolia, *Ridl.* A small tree, endemic and rare, Penang. (11235, and collected here by Ridley).

Lindera selangorensis, *Ridl.* A shrub or small tree, endemic, Semangkok Pass and Gunong Mengkuang Lebah. (11003).

HERNANDIACEAE.

Illigera lucida, *Teysm. and Binn.* A slender climbing of Java; in the Peninsula not common, Perak, Johore. (11484 at 3800 ft., 11194).

PROTEACEAE.

Helicia Kingiana, *Prain.* A tree, endemic, not common, Taiping Hills and Gunong Batu Puteh. (11173)..

LORANTHACEAE.

Loranthus malaccensis, *Hook. fil.* A parasitic bush, endemic and not common in open places. (11144 at 3700 ft.).

Loranthus productus, *King.* A parasitic shrub, endemic and rare, Taiping Hills and Ulu Batang Padang. (11389 at 3500 ft.).

Elytranthe albida, *Bl.* A large parasitic shrub of Indo-Malaya; in the Peninsula Penang to Singapore, not very common. (11308).

Elytranthe avenis, *G. Don.* A parasitic shrub of Sumatra and Java; in the Peninsula montane, Kedah Peak, Perak, Pahang. (11323).

SANTALACEAE.

Henslowia Ridleyi, *Gamble.* A climbing parasitic shrub, endemic and montane, Gunong Tahan, G. Benom. (11286).

OPILIACEAE.

Lepionurus sylvestris, *Bl.* A small shrub of Siam, Java and Borneo; common in the Peninsula. (11384 at 3800 ft.).

BALANOPHORACEAE.

Balanophora truncata, *Ridl.* A parasite, endemic and montane in the Taiping Hills and the Main Range. (11132 at 3700 ft.).

EUPHORBIACEAE.

Aporosa Maingayi, *Hook. fil.* A small tree, endemic, Kedah to Singapore, usually lowland. (11317).

Aporosa lunata, *Benth.* A tree of Sumatra and ?Java; in the Peninsula Penang, Perak, Pahang, Singapore. (11388 at 3200 ft.).

Baccaurea Griffithii, *Hook. fil.* A tree, endemic and common. (11123 at 3700 ft.).

Baccaurea parviflora, *Müll. Arg.* A small tree of Burma, Sumatra and Borneo; in the Peninsula common. (11302).

Baccaurea velutina, *Ridl.* A tree, endemic and local. (11319, also collected by Ridley at the Semangkok Pass).

Galearia affinis, *Hook. fil.* A shrub of ?Siam; in the Peninsula common. (11379).

Macaranga sp. Apparently a species new to the Peninsula, but flowers have not been collected. (11161).

URTICACEAE.

Gironniera subaequalis, *Planch.* A tall tree of Ceylon to the Philippines and New Guinea, and S. China; in the Peninsula common. (11334).

Ficus villosa, *Bl.* A strong climbing shrub of Sumatra to the Philippines; in the Peninsula Penang to Singapore. (11486 at 3800 ft.).

Artocarpus polyphema, *Pers.* A tall tree of Java; in the Peninsula common. (11254).

Laportea stimulans, *Miq.* A small tree with stinging hairs, of Siam, Java and Borneo; in the Peninsula not uncommon in the north. (11193).

Villebrunea sylvatica, *Bl.* A tree of Java; in the Peninsula not common, Selangor and Negri Sembilan. (11093 at 3700 ft.).

JUGLANDACEAE.

Engelhardtia Wallichiana, *Lindl.* A tall tree, endemic, Penang, Taiping Hills. (11305).

CUPULIFERAE.

Pasania conocarpa, *Schky.* A tall tree of Sumatra, Java and Borneo; in the Peninsula not uncommon, usually in the lowlands. (11231).

Pasania ?Scortechinii, *Schky.* A tall tree, endemic and rare, Taiping Hills. (11315).

Pasania ?Wenzigiana, *Gamble.* A tall tree of Borneo; in the Peninsula not common, Penang and Perak. (11077 at 4800 ft.).

ORCHIDACEAE.

Bulbophyllum oeneum, *Burkill.* A small creeping herb, endemic and local. (11298, Burkill and Holttum 8676).

Eria Scortechinii, *Hook. fil.* An epiphytic herb, endemic and montane, Gunong Tahan, G. Benom, and the Main Range. (11061 at 4800 ft. and collected here by Ridley).

Trichotosia microphylla, *Bl.* A creeping epiphyte of W. Malaysia; in the Peninsula rare, known only from this locality (Burkill and Holttum 7799).

Phreatia listrophora, *Ridl.* A small epiphyte, endemic and montane, Langkawi, Gunong Tahan, Taiping Hills. (11396, and collected in this neighbourhood by Ridley).

Ceratostylis ?cryptantha, *Ridl.* A dwarf tufted epiphyte, endemic, Penang Hill, Taiping Hills. (11239).

Chelistonele perakensis, *Ridl.* An epiphyte, endemic and usually montane, Perak, Pahang and Singapore. (11300).

Appendicula robusta, *Ridl.* An erect terrestrial herb, endemic and local. (Burkill and Holttum 8856 at 3600 ft.).

LILIACEAE.

Tupistra grandis, *Ridl.* A herb, endemic and montane, Gunong Kerbau, Bujong Malacca, Batang Padang, Perak. (11381 at 3900 ft.).

Dracaena elliptica, *Thunb.* A shrub of Indo-Malaya; in the Peninsula Kedah to Singapore. (11189).

PALMAE.

Areca pumila, *Bl.* A small palm of Siam and Java; in the Peninsula Langkawi to Singapore. (11255).

Daemonorops callicarpus, *Mart.* A tufted palm, endemic, Penang to Johore. (11208).

Daemonorops geniculatus, *Mart.* A rattan, endemic, Kedah to Singapore. (11131 at 3700 ft.).

PANDANACEAE.

Pandanus globuliferus, *Ridl.* A small shrub, endemic and local. (11022. First collected here by Ridley in 1911).

Pandanus Houllettianus, *Carr.* A shrub, endemic, not common. Negri Sembilan, Johore, Singapore. (11256).

ARACEAE.

Amorphophallus sp. A large tuberous herb, of which a fruiting specimen only was collected. (11002).

Alocasia denudata, *Engl.* A herb of Lingga and Borneo; in the Peninsula Langkawi to Singapore. (11108 at 3700 ft.).

Homalomena caerulescens, *Jungh.* A herb of W. Malaysia; in the Peninsula common. (11380).

Homalomena mixta, *Ridl.* A herb, endemic and rare, Tahan river. (11091 at 3700 ft.).

Schismatoglottis mutata, *Hook. fil.* A herb, endemic, not common, Perak, Kelantan. (11287, and Burkill and Holttum 8696 may be this).

Pothos Barberianus, *Schott.* A climbing herb of Sumatra and Borneo; in the Peninsula Taiping Hills and the Dindings. (11145 at 3700 ft.).

CYPERACEAE.

Scleria radula, *Hance.* A sedge of Hongkong; in the Peninsula rare, Gunong Tahan, G. Kerbau. (11117 at 3700 ft.).

GRAMINEAE.

Thysanolaena agrostis, *Nees.* A tall grass of India to New Guinea; in the Peninsula not uncommon in hill forest, but not occurring south of Fraser Hill. (11157).

Bambusa pauciflora, *Ridl.* A small bamboo, endemic and local. (11234).

M. R. Henderson.

RAINFALL

at the Botanic Gardens, Singapore, during the first half of the year 1925.

Readings taken at 9 a.m. and expressed in inches.

Date	Jan.	Feb.	March	April	May	June
1	..	.01	..	..	..	..
2	.01	2.39	..	..	.09	..
3	..	2.84	..	..	.11	..
4	.11	.35	..	.19	..	..
5	.37	1.76	.10	.34	.40	.09
6	.77	1.01	..	.34	.46	..
7	1.01	1.84	.01	.17	..	..
8	7.88	.15	1.04	..	..	..
9	2.06	.09	1.56	..	..	..
10	.22	.06	..	.06	.90	.05
11	.15	.31	.12	.09	..	trace
12	5.07	trace	.62	.01	..	.18
13	.24	.72	.40	..	..	.72
14	.18	.69	.26	..	..	.98
15	..	.21	..	2.21	..	..
16	.44	.19	.26	..	trace	..
17	.05	..	.06	.11	.11	.97
18	.14	..	.63	.22	..	..
19	.04	.10	trace	..	..	.25
20	..	.16	..	.28	.91	.03
21	..	.63	..	..	trace	.20
22	trace	.59	..	..	.28	.19
23	1.19	.02	2.59	..	.12	..
24	trace	..	.01	..	4.91	..
25	.04	..	1.64	..	.01	..
26	..	..	..	..	..	..
27	.23	..	.05	.11	.21	..
28	..	..	..	.38	.07	.83
29	.34	..	.27	.02	..	trace
30	..	..	.01	..	1.99	1.43
31	.63	..	.05	..	.01	..
Total	21.47	14.12	9.68	4.83	10.58	5.92

RAINFALL

at the Botanic Gardens, Singapore, during the second half of the year 1925.

Readings taken at 9 a.m. and expressed in inches.

Date	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	.01	1.58	.08	..	..	.02
2	.34	trace	.41	.31	.16	.06
3	.44	..	.76	..	.25	.12
4	..	1.33	1.29	.50	..	1.53
5	..	..	.55	.32	..	.40
6	..	.30	..	.18	trace	.84
7	1.22	.01	..	1.32	.79	.10
8	..	.83	.39	2.92	..	.03
9	..	.81	..	.41	1.85	.16
10	..	..	.01	.02	.39	trace
11	..	..	.30	.01	.06	.20
12	..	..	.02	..	..	.40
13	.03	..	1.47	..	..	.01
14	..	trace	.01	..	.71	.14
15	..	..	..	1.78	.61	.12
16	.01	..	.04	..	.13	.76
17	..	..	.01	1.99	3.14	.18
18	.02	..	.03	trace	trace	.77
19	trace	1.94	..	2.51	..	trace
20	..	trace	.18	.38	..	..
21	.21	..	.05	.79	trace	1.91
22	.02	1.50	..	.25	.22	trace
23	..	.01	..	..	.02	..
24	..	..	.23	..	..	.01
25	.06	..	..	.25	.16	.03
26	..	trace	..	trace	.32	.01
27	trace	.15	..	..	.04	.96
28	..	..	..	.05	1.56	1.04
29	..	trace	..	..	.64	.49
30	..	.25	..	.78	.86	1.00
31	.20	..	..	.01	..	.40
Total	2.56	8.71	5.83	14.78	12.21	11.69

RAINFALL

at the head of the Waterfall Gardens, Penang, during the first half of the year 1925, in inches.

Readings taken at 8 a.m., and credited to the date in which the twenty-four hours began. Data kindly supplied by the Municipal Commissioners of George Town, Penang.

Date	Jan.	Feb.	March	April	May	June
1	.34	..	.21	.09	.42	..
2	..	.07	..	2.10	..	.64
3	.02	.02	..	.05	.23	..
4	..	..	.69	..	1.12	.15
5	.62	..	..	1.63	..	..
6	.02	.44	.16	1.82	2.05	..
7	.06	.03	.18	.37	.05	..
8	.07	..	.24	..	..	.22
9	..	..	.02	..	.62	..
10	.29	..	..	.06	.13	.14
11	..	..	.60	.18	..	..
12	.03	..	1.76	..	..	..
13	.58	.03	.57	.04	3.22	3.17
14	.05	..	.31	.86	..	.72
15	.91	..	..	1.65	.08	..
16	.08	.17	1.81	.28	.27	.52
17	.78	..	.03	.39	1.05	.90
18	.02	..	.25	.55	..	.46
19	..	..	.10	.12	.07	1.26
20	..	.09	..	.05	.95	1.53
21	.04	.10	..	..	.22	5.43
22	..	..	.45	..	.10	.58
23	..	..	5.57	.14	.02	.02
24	..	..	2.66	..	..	..
25	..	..	.03	.02	..	..
26	..	..	.24	1.22	..	..
27	..	..	.27	.32	.18	..
28	..	..	1.19	.20	.32	..
29	..	..	.78	.50	..	..
30	.18	..	..	.84	.18	..
31	1.87	..	.16	..	..	..
Total	5.96	.95	18.28	13.48	11.28	15.74

RAINFALL

at the head of the Waterfall Gardens, Penang, during the second half of the year 1925, in inches.

Readings taken at 8 a.m., and credited to the date in which the wenty-four hours began. Data kindly supplied by the Municipal Commissioners of George Town, Penang.

Date	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	.06	.44	.07	.53	.90	..
2	..	..	.94	.37	.24	.15
3	..	.93	.03	.03	.10	.55
4	..	.28	.75	.30	..	.03
5	..	.03	1.73	10.43	..	.06
6	.52	.88	.56	5.59	.29	..
7	.40	..	.03	7.60	.11	.03
8	.89	..	1.76	2.49	.11	..
9	..	.14	.68	3.85	1.12	.10
10	..	..	..	2.18	.03	.03
11	..	..	2.96	1.20	..	.41
12	..	.55	.03	.12	.07	.20
13	..	..	.10	.09	..	.15
14	..	.49	.15	1.98	.90	.54
15	..	1.20	..	..	1.84	1.21
16	..	.57	..	.16	.04	.09
17	..	.16	.36	.22	.13	.12
18	.03	2.14	..	..	..	..
19	.45	1.79	.46	.66	.74	..
20	..	.17	.10	.68	1.87	..
21	.03	.03	.07	.90	.04	.03
22	..	.62	..	1.15	1.57	2.38
23	.10	.03	1.28	1.30	.03	..
24	..	.80	.04	..	..	.03
25	.12	.39	.60	.93	.32	..
26	.17	.04	..	.25	4.18	..
27	1.66	.40	..	.52	.42	..
28	1.62	..	1.20	.28	1.62	..
29	..	..	.03	..	.25	..
30	.07	..	..	..	3.55	..
31	1.23	..	..	1.92	..	..
Total	7.35	12.08	13.93	45.73	20.17	6.11

RELATIVE HUMIDITY for the year 1925 from wet and dry bulb readings made at 9 a.m. in the Botanic Gardens, Singapore.

Date.	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	77	75	78	65	77	74	83	79	91	74	85	89
2	69	95	74	86	81	79	74	79	93	87	70	74
3	68	98	72	79	79	...	91	75	83	76	82	74
4	79	93	81	68	77	65	73	75	93	85	86	95
5	74	97	92	96	74	89	73	75	85	79	77	87
6	83	98	82	95	72	72	79	89	76	78	70	95
7	83	100	85	86	77	76	86	84	75	86	70	78
8	97	88	97	78	74	72	75	100	80	93	74	86
9	79	86	77	76	83	74	72	78	77	85	82	93
10	83	78	75	79	81	86	79	77	87	73	75	86
11	89	86	78	83	79	74	76	79	77	81	73	95
12	78	85	78	80	72	78	77	79	84	77	66	88
13	80	91	88	75	72	79	79	77	86	74	66	75
14	81	83	79	79	79	83	77	81	75	79	71	73
15	81	91	77	77	68	73	79	71	73	78	69	78
16	82	84	74	83	76	74	74	79	77	72	72	81
17	77	73	88	77	81	87	75	79	79	77	75	81
18	85	72	82	70	74	77	83	73	70	82	68	83
19	77	91	68	79	76	79	72	95	77	85	77	72
20	84	93	76	76	78	89	74	81	81	73	72	76
21	75	78	68	77	77	83	79	71	74	95	69	78
22	76	80	74	76	83	87	77	73	72	81	80	80
23	75	78	68	70	81	76	71	83	75	81	72	80
24	84	71	75	79	83	87	68	68	70	87	69	73
25	73	86	75	74	76	79	93	75	70	86	76	82
26	77	69	83	72	79	79	79	83	69	64	89	82
27	87	72	80	72	93	74	79	81	68	71	83	98
28	76	71	74	91	79	79	75	73	68	91	81	91
29	93	...	93	72	75	75	75	76	70	66	95	79
30	76	...	76	67	90	93	74	81	70	77	89	83
31	95	...	80	...	74	...	89	81	...	91	...	95
Mean	80.4	84.3	79.0	77.8	78.0	79.0	77.7	79.0	77.2	80.1	76.2	83.0

Mean for the year 79.3

Summary of Rainfall, 1925.

	SINGAPORE				PENANG			
	No. of rainy days	Amount of rain		Longest Spell without rain	No. of rainy days	Amount of rain		Longest Spell without rain
		inches	mm.			inches	mm.	
January	23	21.47	527	2 days	17	5.96	146	8 days
February	21	14.12	346	9 „	8	.95	23	9 „
March	19	9.68	237		23	18.28	448	2 „
April	16	4.83	118	6 „	23	13.48	330	2 „
May	17	10.58	259	5 „	19	11.28	276	3 „
June	14	5.92	145	5 „	14	15.74	386	8 „
July	13	2.56	68	5 „	14	7.35	180	9 „
August	16	8.71	216	4 „	21	12.08	296	4 „
September	17	5.83	142	7 „	22	13.93	341	2 „
October	21	14.78	362	3 „	26	45.73	1120	1 „
November	21	12.21	300	2 „	24	20.47	502	2 „
December	29	11.69	286	1 „	17	6.11	150	8 „
Total	227	122.38	3006		228	171.36	4198	

Greatest amount in 24 hrs.	7.88 ins. or 191mm.	10.43 ins. or 256 mm.
„ „ 48 hrs.	9.94 ins. or 243mm.	16.02 ins. or 392 mm.
„ „ 72 hrs.	10.95ins. or 268mm.	23.62 ins. or 579 mm.
Excessively rainy periods, over 5 ins. having fallen in 72 hours	3 (Jan. (2) Feb.)	6 (March, June, Oct. (3), Nov.)
Excessively dry periods, less than .02 in. having fallen in 120 hours	8 (Feb. March, Apr., May, June, July (2) Aug., Sept.)	6 (Jan., Feb. (2), June, July, Dec.)

Departmental Notices.

A list of plants which can be purchased at the Botanic Gardens, in Singapore and in Penang, can be had upon application. The same list appears at intervals in the Government Gazette.

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